ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $10.00; FOREIGN, $12.00 (£2 10s.)

Volume XXIII NOVEMBER, 1916 Number 5

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

EDITORIAL STAFF

FOR AMERICA

John B. Murphy, M.D.

E. Wyllys Andrews, M.D. J. Clarence Webster, M.D.

L. L. McArthur, M.D.	E. C. Dudley, M.D.	Frederic A. Besley, M.D.
A. J. Ochsner, M.D.	C. S. Bacon, M.D.	William R. Cubbins, M.D.
Thomas J. Watkins, M.D.	Carl Beck, M.D.	John C. Hollister, M.D.
Major G. Seelig, M.D.	John L. Porter, M.D.	Rudolph W. Holmes, M.D.

FOR THE BRITISH EMPIRE

A. W. Mayo-Robson, C.V.O., D.Sc., F.R.C.S.

Sir Berkeley Moynihan, M.S., F.R.C.S. Thomas W. Eden, M.D., F.R.C.S.

Harold J. Stiles, M.B., F.R.C.S. (Edin.) Henry Jellett, M.D., F.R.C.P.I.

James Rutherford Morison, M.B., F.R.C.S.

Franklin H. Martin, M.D., Managing Editor

Allen B. Kanavel, M.D., Associate Editor

EDITORIAL AND BUSINESS OFFICES: 30 N. Michigan Ave., Chicago, Illinois, U. S. A.

PUBLISHERS FOR GREAT BRITAIN: Bailliere, Tindall & Cox, 8 Henrietta St., Covent Garden, London, W. C., England

THE NEW (7th) EDITION

DaCosta's Modern Surgery

In revising this book so much new matter was added that the work had to be reset from cover to cover. By the use of a slightly larger page and different type, however, it was possible to keep the volume within reasonable bounds. Dr. DaCosta's book gives you both *principles and practice* of surgery, and so thoroughly does it go into diagnosis that it is really a *surgical diagnosis* as well.

Octavo of 1515 pages, with 1085 illustrations. By J. CHAMBERS DACOSTA, M. D., Samuel D. Gross Professor of Surgery, Jefferson Medical College. Cloth, $6.00 (25s) net; Half Morocco, $7.50 net.

SAUNDERS, *Publishers*

See Page 13

Entered as second-class matter May 22, 1913, at the postoffice at Chicago, Ill., under the Act of Congress, March 3, 1897.

Copyright, 1916, by The Surgical Publishing Company of Chicago.

Why Hide Your Light Under a Bushel?

In your X-Ray work, get the *best* your machine is capable of. Unless you *do*, you are not getting credit for *all* the skill you have.

The little outfit, *properly handled*, will do as fine work as the large one, and *speed* in exposure can be gained by using Paragon X-Ray Plates—because they are so remarkably fast.

Do your plates have a rich black background. If not, do you know the reason why? Soft tubes make rich black background, and at the same time give fine tissue and bone detail—*if you use Paragon X-Ray Plates.* There's a reason for this fact. Try Paragon X-Ray Plates and you will appreciate it.

Good X-Ray work always pays—and pays well—in money and in reputation.

Paragon X-Ray Plates produce maximum efficiency, from any apparatus—and we help Paragon Plate users on technical points.

Our interest does not end with getting your order—that is only the first step. After that we want you to know the *best* way to expose and develop—your success means our success.

Try Paragon Milli-ampere-second Technique. It puts mathematical accuracy into X-Ray work—in exposure and development. If you haven't it, send for "Paragon Pointers"—our free book on Radiography—and refresh your memory.

There are no better plates than the Paragon

Geo. W. Brady & Co., 756 S. Western Ave., Chicago

CHICAGO LABORATORY
PROMPTNESS · EFFICIENCY
CLINICAL
ANALYTICAL

The CHICAGO LABORATORY

Marshall Field Annex Building
25 EAST WASHINGTON STREET
Telephone Randolph 3610 **CHICAGO**

Modern equipment, combined with years of clinical and analytical experience, is at your service. Our reputation and names stand back of our work.

Moderate prices. Fee tables, sterile containers, etc., sent on request.

Prompt reports by mail, telephone or telegraph.

RALPH W. WEBSTER, M.D., Ph.D.
Director of Chemical Department

THOMAS L. DAGG, M.D.
Director of Pathological Department

C. CHURCHILL CROY, M.D.
Director of Bacteriological Department

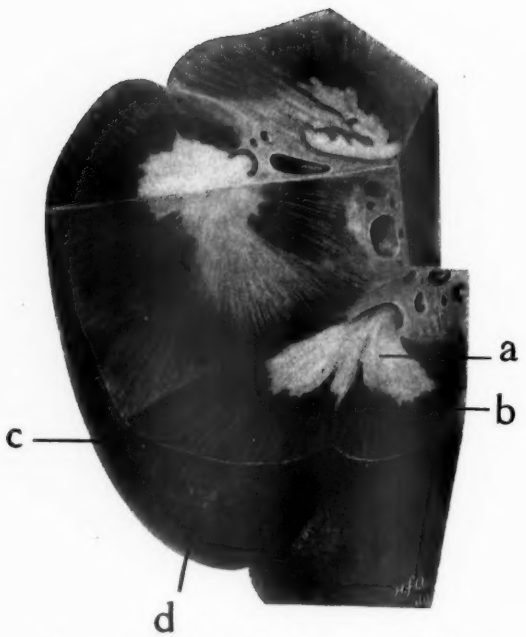


Fig. 1. Nephritis papillaris mycotica (Orth). A bilateral mixed colon bacillus and streptococcus pyogenes infection of hæmatogenous origin. *a*, Necrotic, anæmic papillæ; *b*, purplish zone surrounding necrotic papillæ; *c*, striations of cortex; *d*, mottling of cortex.

(*Hugh Cabot.*)

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIII NOVEMBER, 1916 NUMBER 5

THE ETIOLOGY AND PATHOLOGY OF NON-TUBERCULOUS RENAL INFECTIONS[1]

BY HUGH CABOT, M.D., BOSTON

Assistant Professor of Genito-Urinary Surgery, Harvard Medical School; and Chief of Genito-Urinary Department, Massachusetts General Hospital

AND

E. GRANVILLE CRABTREE, M.D., BOSTON

Assistant in Genito-Urinary Surgery, Harvard Medical School; and Assistant Genito-Urinary Surgeon, Out-Patient Department, Massachusetts General Hospital

WHILE it is almost literally true that a satisfactory comprehension of the diseases of the genito-urinary tract depends upon a clear appreciation of the nature and probable course of renal infection, there is no subject in which there is so little uniformity of opinion and so much confusion. The literature of the subject is stupefying both in quantity and in complexity, and anyone who has attempted to master it will, we think, be convinced of the fact that it is more likely to confound than to enlighten the reader. Not a little of the confusion arises from a somewhat inaccurate use of terms. Thus, the great majority of writers using the term "ascending renal infection" mean a process which ascends from the lower to the upper urinary tract, but Mallory has for some reason seen fit to use the term to mean ascension from the renal pelvis into the kidney substance and has confused without enlightening. The phrases "metastatic, embolic, hæmatogenous, bloodborn" have been used with a looseness which defies comprehension, and finally, the persistent description of various stages in the same process as different pathological entities has rendered confusion worse confounded. Not the least serious difficulty has arisen in the almost entire failure of collaboration between the clinician and the pathologist. Thus 20 years ago Orth showed a very interesting understanding of the etiology of renal infections which the clinicians have apparently largely overlooked. On the other hand, as in the ancient history of renal tuberculosis, the pathologist has wrought havoc with an understanding of this subject because his opinions have been based considerably upon post-mortem material, which it might be suggested, is likely to represent fatal cases, and has therefore jumped to the conclusion that a given type of lesion is generally bilateral, whereas in fact it is bilateral only in the fatal cases.

A more or less intimate association with the subject of these infections, early impressed us with the complexity of the picture which may be presented by kidneys which are the site of long-standing infection. It is not rare to find kidneys showing the evidences of at least three infections differing in point of time and often in the nature of the organism involved. That these should present to the pathologist a situation almost too complicated for satisfactory solution is not surprising and

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, May, 1916.

we have come to believe that many of them can be interpreted only in the light of considerable knowledge of the clinical history coupled with great familiarity with renal pathology. In the attempt to solve the intricate problems of renal infections much assistance has been rendered by the use of animal experimentation and yet it has in some hands led to wholly erroneous conclusions which have done considerable damage, the error arising very largely from the attempt to draw conclusions from the effect upon animals of organisms whose behavior is very different from that which they exhibit in the human body. Thus, the colon bacillus rarely produces suppurative lesions of the kidney in man, while in animals it may readily do so; and this has given rise to the quite erroneous assertion that the colon bacillus commonly, or even regularly, produces abscesses of the kidney. Where so much turns upon the exact nature of the lesion produced, a study of the lesions in animals must be surrounded with every precaution, if the conclusions are to have validity. Our experience has led us to the conclusion that it is wholly unsafe to use the same organisms commonly found in human renal infections in carrying out animal experiments, and we incline to the view that the safest procedure is to select organisms which produce similar lesions in other organs and reason from parallel rather than from identical lesions. In studying this subject we have come to regard it as important to consider the lesions produced by various organisms upon kidneys previously normal, in order to get a clear understanding. It has seemed to us that in the past, attempts to explain the lesions produced by infection upon kidneys previously damaged has been a potent source of error and that an understanding of the lesions found under these conditions is most likely to come through a study of the lesions produced in previously healthy kidneys. Therefore, in discussing the subject we have divided the field of renal infections into two groups: Group I, including only those kidneys which were previously normal as far as the clinical evidence will permit of a decision, and Group II, those in which infection was grafted upon some other lesion of the kidney, such as stone, tumor, or dilatation due to obstruction.

Bacteria circulate in the blood and are excreted by the kidney without producing gross lesions

Many years ago various observers, including Hoffman, Roehrig, Maas, Wiener, Rutimeyer, and Cohnheim showed that insoluble substances such as cinnabar and fat could be made to pass through the healthy kidney. Particles of these substances were found in the capsule of the glomerulus, in the tubules, and in the urine. In 1896 Biedl and Kraus showed that the staphylococcus aureus, the bacillus coli, and the anthrax bacillus, passed through the healthy kidney. The same fact was demonstrated for the typhoid bacillus by Lumiere and Abrami; by Rovsing for the bacillus coli; by Cuturi for the same organism; and by Patrick for various organisms in the course of typhoid fever. Meyer, Walschmann, Heyer, Kramer, Buday, Wyssokowitsch, Rolly, Brown, and Cunningham have shown that, in the course of tuberculous lesions elsewhere in the body, tubercle bacilli appear in the urine at various times and in varying quantities without any evidence of damage to the kidney. Honeij has made a similar observation for the bacillus of leprosy. In this connection should be mentioned an interesting series of observations noted by Swart and Craig, that, following the administration of salvarsan to patients with leprosy or patients with tuberculosis, the bacilli appear in the urine in large numbers and the course of the disease is often unfavorably affected. On the other hand, Wyssokowitsch in 1886, experimenting with a variety of pathogenic bacteria including the pneumococcus, the typhoid bacillus, anthrax bacillus, and the staphylococcus aureus, found them appearing in the urine with evidence of the production of kidney lesions. Similar conclusions were drawn by Cocordi in 1888, Pernice and Scagliosi in 1892, Sherrington in 1893, Cotton in 1895, and Jahn in 1910. This array of apparently conflicting testimony has brought certain eminent observers to the conclusion that in the cases

where no lesion was discovered it was because a slight lesion had been overlooked. This we believe to be an entirely unwarranted conclusion. In view of the fact that insoluble substances have been shown to pass the kidneys without damage; in view of the fact that many competent observers have passed bacteria through the kidney repeatedly and then examined these kidneys after sacrifice of the animal; and in view of the fact that we are daily accepting the clinical evidence obtained by the study of patients in regard to the integrity of their kidneys, we cannot avoid the conclusion that bacteria pass the healthy kidney. That they do not do so always or under all conditions simply confirms the well-known fact that local conditions in the kidney and general conditions in the organism influence the occurrence or non-occurrence of infections. While we are prepared to admit the accuracy of all the observations above quoted, they seem to us to prove conclusively that organisms circulate in the blood and pass through the kidney, in many cases without producing any lesion and in many other cases with the production of various lesions.

BACTERIA CIRCULATE IN THE BLOOD AND ARE EXCRETED THROUGH THE KIDNEYS WITH LESIONS MILD OR SEVERE

In 1915 Kowitz, studying a group of children with infectious diarrhœa, found the following sequence of events in five cases:

Blood cultures showed the baccilus coli. Promptly thereafter there appeared in the urine first albumin, then bacteria, and finally pus. Exploration of the records of the medical services at the Massachusetts General Hospital has yielded us an interesting series of 8 cases of bacillæmia and bacilluria which it may be noted occurred entirely in women. They entered the hospital with the diagnosis of fever of unknown origin.

CASE 1. Woman, age 35. Blood culture showed bacillus coli; urine, profuse growth of the same organism. Physical examination negative except for elevation of pulse and temperature. Recovery.

CASE 2. Woman, age 29. Physical examination negative. Temperature 103. Pulse 120. Widal negative. Blood culture, unknown bacillus; urine, bacillus coli; stool, persistently negative for typhoid bacilli.

CASE 3. Woman, age 20. Entrance diagnosis: paratyphoid. Blood culture, bacillus coli; urine culture, colon-like bacilli. Recovery.

CASE 4. Woman, age 23. Sister of Case 3. Entrance diagnosis: paratyphoid. Blood cultures lost; urine culture, bacillus coli. Recovery.

CASE 5. Woman, age 30. Entrance diagnosis: question of typhoid. Blood cultures, profuse growth colon bacillis; bladder urine, colon bacillus; right ureter, colon bacillus; left ureter, no growth. Persistent right pyelitis.

CASE 6. Woman, age 35. Entrance diagnosis: unknown fever. Temperature 102. Pulse 95. Blood culture, colon bacillus; urine culture, colon bacillus. Recovery.

CASE 7. Woman, age ? Entrance diagnosis: acute infection. Temperature 100.5. Pulse 98. Blood culture, motile bacillus (bacillus paratyphoid?); urine, bacillus coli. Death in one week. No autopsy.

CASE 8. Woman, age 62. Entrance diagnosis: convulsions. Temperature 102. Pulse 110. Blood culture, colon-like bacilli; urine culture, colon-like bacilli. Death in one week. Autopsy: calculus, pyonephrosis, bilateral suppurative nephritis.

This group of cases is interesting from several points of view. Most of them were regarded as cases of probable typhoid and attention was particularly directed to this condition. Their blood, however, failed to show a Widal or to react to cultures of the paratyphoid bacillus and they were finally proved to be due to the other member of this group, the colon bacillus. We believe that these cases simulating typhoid and due in fact to the colon bacillus, in other words, cases of colon bacillus bacillæmia, are much more common than has been generally supposed. The records of any large hospital during recent years will show a considerable number of these cases in which clinical symptoms suggested typhoid, but the diagnosis could not be confirmed and they were finally discharged cured, often with a diagnosis of paratyphoid. A correct solution can be obtained only by careful study of the blood and urine with good technique, and particularly when they are seen at an early stage of the disease.

That the colon bacillus can be obtained from the blood in cases of acute pyelonephritis with considerable frequency has recently been shown by one of us (E. G. C.), who, in a series of 32 cases obtained positive blood cultures in 40 per cent, a ratio larger than that

ordinarily obtainable in typhoid fever which is admitted to be a bacillæmia. One case occurring under our observation and carefully studied throws considerable light upon the natural history of this process.

The patient was a man of 55 with benign enlargement of the prostate gland and residual urine. Cultures controlled by stained sediment showed the urine free from infection at entrance to the hospital. He was immediately placed upon constant drainage with an inlying catheter. Cultures from the bladder urine were taken the evening of the seventh day, up to which time he had complained of no symptoms whatever. These were sterile. At eleven o'clock of the eighth day he complained of a burning sensation in the urethra and two hours later had chill and sudden sharp rise in temperature. Blood cultures were taken two and one-half hours from the beginning of symptoms of prostatic irritation and one-half hour after the appearance of the chill and rise of temperature. A pure growth of colon bacilli was obtained. Centrifuged urine obtained from the bladder at the time the blood culture was taken showed no bacteria in stained sediment. Cultures taken from the bladder urine the following morning showed an abundant growth of colon bacilli. Pus was present in very small amount. The renal functional test with phenolsulphonephthalein showed a drop in 24 hours of 20 points. The patient complained of right-sided costovertebral tenderness and headache and presented the usual symptom-complex commonly called pyelitis, which we believe to be a pyelonephritis. He was allowed to remain on constant drainage for a week longer, during which time his phthalein output returned to within five points of its former level. Perineal prostatectomy was then done. The patient made an uneventful recovery until the ninth day, when he bled. The wound was packed and bleeding controlled. The temperature rose and the patient died. Necropsy showed anæmia and streptococcus septicæmia. The kidneys were pale with normal markings and little, if any, dilatation of the pelvis (Fig. A). They were passed by the pathologist as normal kidneys.

This case clearly shows bacillæmia, bacilluria, pyelitis and pyelonephritis. The evidence of pyelonephritis is based chiefly upon the sudden great drop in kidney function, which we think may be taken as evidence of acute cloudy swelling of the kidney, probably involving chiefly the tubular portion. That this process is short-lived and goes on rapidly to practically complete recovery is suggested by the return of kidney function and conclusively proved by the appearance of the kidney post-mortem.

Finally in support of the above-mentioned proposition we submit the results of the inoculation of a rabbit with the paratyphoid bacillus alpha. It should be remembered that the paratyphoid bacillus has for rabbits a pathogenicity quite similar to that shown by the colon bacillus in man. The cultures used in this experiment were three-year old cultures. At the beginning of the experiment the bladder urine was shown to be sterile. An emulsion of the organisms, about 3 cubic centimeters in amount, was introduced into the ear vein on three separate occasions during a period of five weeks. Following each injection the organisms appeared in the urine promptly and in enormous numbers. Five days following the last injection the animal was sacrificed. Sections of the kidneys carefully studied showed practically no lesion and were certainly within normal limits for laboratory animals (Fig. B).

ASCENDING INFECTION BY WAY OF THE URINARY PASSAGES

The theory that infections reach the kidney by direct extension from the lower urinary passages has acquired the dignity associated with old age and has been a widely held and attractive theory because of its extreme anatomic simplicity. We believe that it can be shown that its simplicity is apparent rather than real, that most of the cases in which it has been supposed to occur were based upon a complete misconception of the facts and that this method must in reality be regarded as exceptional. It has been customary to assume that in this method of renal infection the bacteria reached the kidney by one of three ways:

1. By continuity from a bladder infection by direct extension of the process within the lumen of the ureter.

2. By the transportation of the bacteria in a column of urine which is supposed to exist within the ureter. By this conception the bacteria float upward, apparently impelled also by their own motive power in contemptuous disregard of the descending stream of urine and ureteral peristalsis.

3. By reverse peristalsis within the ureter. This, of course, presupposes obstruction of

the ureter, since as far as we know there is no warrant for the assumption of reverse peristalsis in the absence of obstruction. That reverse peristalsis occurs in the presence of obstruction we believe to be a demonstrated fact, the best evidence of which in our personal experience has been the movement of ureteral calculi from the kidney to the lower end of the ureter and then back again, a journey which could hardly be expected to take place under any force other than reverse peristalsis.

The whole theory of ascending infection rests primarily upon the proposition that infection of the bladder takes place under a great variety of conditions unassociated either with trauma or with retention, for unless a pre-existing cystitis is assumed, the whole proposition falls to the ground as applied to a great majority of the cases.

More than a quarter of a century ago Rovsing and Melchior showed that (a) experimentally cystitis could not be produced in animals without retention or trauma; that (b) with retention of urine experimentally produced there generally resulted no pyelitis; that (c) trauma to the bladder with or without retention produced pyelitis and pyelonephritis. In passing it should be noted that in these later cases sections of the bladder-wall showed extensive hæmorrhage with bacteria in the blood and lymph-channels, an observation the importance of which will later appear.

Bauereisen, concerning himself wholly with the lesions produced by the tubercle bacillus, drew three conclusions: (1) A bladder with intact mucosa cannot be infected. (2) With the flow of urine unhindered, tubercle bacilli cannot reach the kidney through the ureter. (3) Obstruction of the urinary stream will as a rule result in urogenous ascending infection of the kidney. This last conclusion implies a dilatation of the ureter and an incompetent ureterovesical valve.

Draper and Braasch, in a very thorough piece of work in which they attempted to produce ascending renal infections, wholly failed to do so except by maintaining an abnormal amount of pressure in the bladder over a long period of time.

It thus appears that the experimental work wholly fails to support the assumption of ascending infection by means of the urinary passages. When produced as by Rovsing and Melchior, there is no warrant for the assumption that it ascended, since the blood and lymph channels were shown to contain bacteria, and it is far more probable that the bacteria reached the kidneys by one or both of these routes. It is notorious that bacteria in the bladder, whether introduced from above or from below, fail over a long period of time to produce lesions. There is a mass of clinical evidence showing that tubercle bacilli coming from an infected kidney will pass for years through the bladder without producing a lesion. Of late years when the cystoscope and ureter catheter have made accurate diagnosis of conditions in the upper urinary tract possible, a multitude of observations have been recorded of colon bacillus pyelitis and pyelonephritis from which the colon bacillus passed to and through the bladder for years without producing a lesion.

A recent communication by Hess, in which he described the results of investigations of the bacteriology of bladders immediately following cystoscopy, throws considerable light upon this question. He showed that in the first days following instrumentation, bacteria of various kinds could be found in the bladder with regularity, that they produced neither the symptoms nor the signs of cystitis and that in a few days they disappeared. We have become wholly accustomed to regarding the cystoscopic examination of the bladder under normal conditions as a harmless procedure. If these observations of Hess be confirmed it shows that the harmlessness consists not in the aseptic character of our procedure but in the vitality of the vesical mucous membrane and its ability to shake off the milder degrees of infection.

We do not intend to convey the impression that we believe that ascending infection from the lower to the upper urinary tract must be wholly discarded for there are two conditions under which it is theoretically possible and practically probable. The first of these is ureteral obstruction, which may theoretically be of three types: that due to stone, that due to inflammatory stricture, and that produced

by the abnormal constriction of the lower end of the ureter by hypertrophy of the bladder such as is seen in diverticulum, in tuberculosis, and in obstructive conditions at or below the neck of the bladder. In hollow viscera elsewhere in the body obstruction is followed by reverse peristalsis with singular regularity and it is but reasonable to assume that the ureter, a hollow muscular organ, behaves in a similar fashion. Further warrant is given to this belief by the observation in regard to stone in the ureter above referred to. Now under conditions of reverse peristalsis, bladder infection with extension by direct continuity to the lowest portion of the ureter would give rise to conditions highly favorable to renal infection if assisted by reverse peristalsis. The other condition clearly opening the way to ascending infection is incompetence of the ureterovesical sphincter such as undoubtedly exists in a certain number of cases of obstruction at or below the vesical outlet. In these cases the dilatation has become so extreme that the renal pelvis is for all practical purposes in direct open communication with the bladder cavity, and any condition existing in the latter will promptly be communicated to the former by the simple method of backwash. Under these circumstances, if the kidney is not already infected, it will promptly become so.

The pyelitis, so called, of pregnancy, and the equally improperly termed pyelitis of childhood, have been the great strongholds of the ascending infectionists. Their theory has been based chiefly on anatomical fact unsupported by clinical or experimental evidence. The short urethra and the comparative ease with which the region of the urinary meatus might be contaminated with the colon bacillus, together with the fact that in the adult female vesical irritability is often the first thing to attract attention, have been the two important premises. It has not been shown that the cystitis antedates the pyelitis, for the good and sufficient reason that such is rarely the case. Furthermore, should it be shown that the cystitis was primary there is no basis either in man or animals for the assumption that with neither retention nor trauma ascension could occur. The fact that this disease occurs with far greater frequency in the female, whether child or adult, is important but its significance has been wholly misunderstood. It is interesting to note that in the eight cases reported above of proved bacillæmia and bacilluria, all were women. In the adult female, we think, there can be no doubt that the conditions normally existing in the large intestine are more favorable to the occurrence of bacillæmia than in the male. There is as yet no adequate explanation of the greater frequency of these infections in the female child, but we think that existing evidence points to the view that this explanation will be found, not in the anatomical peculiarities of the female urethra, but in the anatomical peculiarities of the female intestine.

ASCENDING INFECTION BY THE LYMPHATICS

For many years occasional observers have called attention to the possibility that bacteria might reach the kidney by way of the lymphatics. It has perhaps been most extensively discussed in connection with renal tuberculosis but of late years the discussion has been extended to include other organisms and a variety of publications showing careful anatomical study have tended to support the theoretical contentions.

Mascagni showed that the lymphatics of the upper ureter drained into the lymphatic system in the region of the kidney pelvis and that organisms might reach the kidney along these channels. He also showed that the lymphatics of the lower ureter drained into the lymph-nodes of the anatomical pelvis.

Sakata confirmed the above observations and further showed that the system of lymphatics of the upper ureter and the system of lymphatics of the lower ureter and bladder were connected by an intermediate chain of lymphatics embracing the central portion of the ureter. It is easy, however, to exaggerate the importance of this observation, since Sakata's work shows that this chain is not continuous, but is, on the contrary, highly interrupted. Organisms in order to extend from bladder to kidney by this route would have to pass through several systems of lymph-nodes, a contingency which importantly decreases the probability of such an occurrence.

Sugimura studied a series of 21 cases and showed that in the presence of acute cystitis the lower third of the ureter was constantly involved, apparently through the medium of the lymphatics. He drew

this conclusion because there was very slight involvement of the mucous membrane of the lower ureter, while the lymph-channels of the muscularis and adventitia were extensively involved.

Francke has shown a lymphatic communication between the right kidney capsule and the adjacent ascending colon.

Kumata has demonstrated a system of superficial and deep lymphatics in the fatty capsule of the kidney. This system apparently drains away from the kidney communicating with the subdiaphragmatic lymphatics.

A recent paper by Eisendrath states his belief that he has demonstrated that bacteria ascend by the lymphatics from the bladder to the kidney and produce renal infection. After a careful study of this paper we regret that we are entirely unable to follow him to his conclusion. The method by which the lesions were produced is nowhere stated. The lesions are not strikingly different from those which are found in blood-born infections and finally the evidence which he submits of the lesions of the kidney is so meager and differs in such important particulars from the infectious lesions ordinarily found in the kidney that we must question their similarity.

Upon the framework of the above-mentioned anatomical observations several writers have attempted to erect a theory of lymphogenous infection of the kidney. Though the framework is valid in its individual members, the complete structure seems to us frail and insecure. It is generally believed, and upon sufficient evidence, that the lymphatic currents throughout the body follow the flow of blood in the blood-vessels. Unless we are prepared to disregard this doctrine it will be difficult to trace lymphatic processes over areas which are totally lacking in continuous vascular channels. Now there are no blood-vessels running an uninterrupted course from the bladder to the kidney. The blood supply of the ureter is distinctively segmental and the only vessels which run in this general direction are the spermatic vessels in the male and the ovarian vessels in the female. These run in different sheaths and would be with difficulty accessible to organisms passing outward from the bladder. Furthermore, assuming the probable fact that organisms reach the lymphatics about the bladder and over the lower segment of the ureter, the probability of their reaching the blood stream rather than continuing in devious lymphatic channels seems to us overwhelming. That organisms pass from the bladder into the perivesical lymphatics, reach the blood stream and ultimately the kidney, we not only believe but are prepared to show,[1] and this possibility must always be reckoned with. Reasoning from lesions produced by lymphatic infections elsewhere in the body, progress by this method is comparatively slow and on account of the interrupting lymph-nodes is more likely to produce highly localized lesions than lesions spreading rapidly over long distances and flooding a distant area with organism.

Finally, the evidence of the lesions actually produced in urinary tuberculosis is enlightening. It is generally recognized that the involvement of the ureter is earliest and most marked at its two extremities and it is not uncommon to find a central portion of the ureter wholly or comparatively free from tubercular disease. Those who have regarded the work of Francke concerning the lymphatic communication between the ascending colon and the right kidney as conclusive, seem to us to be reasoning upon highly insecure premises. Arbeiter has shown that when organisms leave the intestine by the lymphatics they rapidly appear in the blood and this tendency is amply confirmed by a large series of observations which concern themselves not only with the migration of bacteria of the intestine into the lymphatics but with the ways in which foreign proteids leave the intestine under abnormal conditions.

Thiele and Embleton have shown that after peritoneal infections the organisms rapidly reach the blood stream and are excreted by the normal kidney. If, however, the thoracic duct be opened so that bacteria can escape, no such excretion occurs.

If for a moment we disregard the large probability that bacteria leaving the intestine by the lymphatics will reach the blood stream rather than the kidney, we must yet believe that a lesion of the kidney thus produced would in all probability be a localized lesion rather than a widespread diffuse lesion such as is notoriously produced by bacteria of intestinal origin.

[1] See author's case, p. 498.

WHY ASSUME THAT COCCI GENERALLY REACH THE KIDNEY BY THE HÆMATOGENOUS ROUTE, WHILE ASSUMING THAT COLON BACILLI GENERALLY REACH THE KIDNEY BY ASCENSION FROM THE BLADDER?

It has been long assumed and, following the work of Brewer, has been almost universally admitted that the staphylococcus infections of the kidney are of hæmatogenous origin. These infections have been shown to be associated with furunculosis, carbuncle, and various septic foci elsewhere in the body. The identity of the organisms in both places and the impossibility of sustaining any assumption of transference other than the blood has led to these lesions being regarded not only as hæmatogenous lesions but the proposition has been even reversed and the hæmatogenous lesion has become almost synonymous with coccus infections. On the other hand, the infection of the kidney with the colon bacillus, of which the purest types are the pyelonephritis of infancy and pregnancy, has been regarded as ascending chiefly because of the delightful simplicity of the assumption. If, however, one inquires as to the evidence of the hæmatogenous origin of both these types of infection one is at once struck by the fact that the hæmatogenous origin of colon bacillus infections has been demonstrated beyond the shadow of a doubt, the organisms having been repeatedly found in the blood and subsequently in the urine, while as far as we are aware there are but few cases on record in which the cocci concerned in the so-called hæmatogenous coccus infection of the kidney has been captured during his journey through the blood. While this should not be taken as in any way tending to invalidate the hæmatogenous origin of the coccus lesion, it seems to us to at once put upon the defensive those who would assume that colon bacillus infections of the kidney are produced by any method other than the hæmatogenous one. At least as far as concerns the pyelonephritis of the group above referred to, we shall later submit evidence which seems to us to show that they can be produced only by organisms reaching the kidney through the blood stream and that the theory of ascension is wholly mythical.

POSSIBLE SOURCES OF CONFUSION IN PREVIOUS STUDIES OF RENAL INFECTION

That the literature of renal infections is both confusing and confused, no one who has attempted to digest it is likely to deny. There appear to us to be two chief sources of this confusion: first, a considerable lack of uniformity in the use of terms which at times amounts to a use so loose as to be positively misleading; and second, an attempt to study complicated and mixed lesions which are likely to almost defy analysis.

1. At the outset, therefore, of the discussion of our own findings we desire to state clearly our understanding of the terms embolic, metastatic, hæmatogenous, excretory, lymphogenous, and ascending, as applied to renal infection.

A suppurative lesion of the kidney we regard as *embolic* when a definite embolus shown to contain micro-organisms has been demonstrated in a blood-vessel at the apex of the lesion. This term has we think frequently been used to cover numerous leisons which were in no proper sense embolic in character.

A *metastatic* lesion of the kidney we understand to mean a suppurative lesion produced by an organism of the same character as one concerned in a demonstrable suppurative lesion elsewhere in the body.

The term *hæmatogenous* we hold to mean simply that the organisms reach the kidney by the blood.

An *excretory* lesion is one produced during the process of excretion of organisms by the kidney. It will thus be seen that the terms hæmatogenous and excretory cover very nearly the same ground. Clearly no excretory lesions can occur unless the organisms have arrived by the blood, and we expect to show that organisms which arrive by the blood and do not produce emboli very generally do produce excretory lesions.

Lymphogenous covers all the suppurative processes demonstrated to be produced in the kidney by bacteria which have arrived solely via the lymphatics.

And finally, *ascending infection*, a much abused term, we hold to mean the direct ascension of organisms from bladder to kidney by the lumen of the ureter. This process may include either a direct extension along a mucous membrane or a direct transference from bladder to kidney with the urine as a vehicle.

2. We believe that a comprehension of renal infections is very much simplified if they be separated into two main groups: Group I including all those infections of the kidney which occur in an organ previously

sound, and Group II those infections which occur in a kidney previously unsound, such as those damaged by stone, tumor, obstruction, or chronic nephritis.

A classification of the infections occurring in Group I has seemed to us after a not inconsiderable experience to be comparatively simple. We have as a rule been able to come to a satisfactory conclusion as to the cause and nature of the process and to arrange the lesions in an orderly and comprehensible fashion. On the other hand, there have been many cases falling under the classification of Group II in which the complication of lesions of various dates and of essentially different pathological characteristics was such as to largely defy satisfactory explanation. For example, a kidney long the resting-place of a stone, may show a variety of practically healed lesions, the original nature of which must be permanently in doubt. Coupled with these may be two, or even three, more recent infections overlapping each other in position and perhaps in point of time, and giving a picture so confusing as to be quite beyond us. It may well be that a more extensive study of the cases in Group I will enable one to make a fairly accurate guess as to the probable cause of the various lesions of such a kidney as above described.

A STUDY OF THE LESIONS ACTUALLY FOUND IN RENAL INFECTIONS[1]

For this study we have utilized a group of 118 cases classified as suppurative nephritis. These include both cases studied at autopsy and specimens obtained at operation so that we have not been confined to one particular type of material. Of these 118 cases we have been obliged to discard 58, either because they represented material obtained at autopsies done several years ago from which the paraffin blocks had been lost, or the lesions were too chronic and too complicated to lend themselves satisfactorily to classification, or finally those in which we were unable to demonstrate bacteria. There thus remains a group of 60 cases divided as follows:

23 were caused by and were demonstrated to contain staphylococci alone;
4 streptococci alone;
3 staphylococci and streptococci;
25 were demonstrated to contain mixed cocci and bacilli —
19 of these showed staphylococci and bacilli,
4 showed streptococci and bacilli,
2 showed staphylococci, streptococci and bacilli;
5 showed bacilli only —
3 the bacillus coli and
2 the bacillus coli and another bacillus clearly a pyogenic organism.

1. EVIDENCE OF THE PRODUCTION OF LESIONS DURING THE PROCESS OF EXCRETION OF BACTERIA

The case for this proposition was clearly stated by J. W. Thomson Walker in his work on *Surgical Diseases and Injuries of the Genito-Urinary Organs*, p. 120.

It is now recognized that bacteria are constantly entering the lymphatics from the intestine and other sources in healthy individuals. The bacteria may be destroyed at the point of entry or at the lymphatic glands, or they may pass through the lymphatic system into the blood stream, in which they circulate. The endothelium and cells of the liver destroy bacteria which are introduced by way of the portal system, and bacteria are excreted in the bile. Similarly a function of the renal parenchyma, especially of the convoluted tubules, is to remove the bacteria present in the systemic circulation.

It has been proved that the virulence of these bacteria is not reduced in their passage through the body. The excretion of bacteria in this way does not give rise to any symptoms which show that the kidneys are damaged. It is stated, however, as the result of experiments on animals, that the secreting membrane is injured by the passage of the bacteria. The damage is probably slight, and is repaired partly or completely by the regenerative powers of the kidney. In some cases long-continued excretion of bacteria or their toxins may be the cause of patches of interstitial nephritis in the kidney.

It is held that the excretion of bacteria does not cause pyelonephritis unless some additional factor is present. Predisposing causes of pyelonephritis are traumatism, excessive functional activity, the elimination of toxic bodies such as cantharides, previous disease of the kidney such as urinary obstruction, calculus, new-growth. It is exceptional,

[1] In all the following case reports, gross description and microscopical examination of sections are copied from the autopsy protocols of Dr. J. H. Wright and Dr. Oscar Richardson. Where specimens from operations are used the above descriptions are copied from the reports dictated by Dr. Whitney and Dr. Hartwell of the laboratory of the surgical pathology department. Where more detailed observations than is possible in routine work were required they are given under the heading of "sections stained for bacteria" which we have appended.

however, to find any of these factors present, and it is more likely that chronic toxæmia from constipation, an excessive dose and an exceptionally virulent strain of bacteria, are the decisive factors.

It was also clearly stated by Orth in 1893:

The question of the method by which bacteria reach the tubules in the pyramidal zones can, in my opinion, only be explained by assuming their passage from the blood into the capsule of the glomerulus and their being carried along into the collecting tubules with the urine where they group together, become arrested, and continue to grow.

We append three cases which seem to us to clearly support the doctrines thus laid down.

CASE 1. Autopsy No. 3539. West Medical, 205300. Female, age 56. November 15, 1915. *Diagnosis:* diabetes mellitus. Past history negative save for present symptoms which appeared four years ago. Present illness — only symptoms are those of diabetes. Physical examination negative as regards urinary tract. Patient was made and kept sugar free with great difficulty and lost weight and strength under the treatment. *Urine examination* at entrance showed sugar 7.8 per cent, diacetic acid and acetone; no albumin, occasional pus-cell. *Urine examination*, January 14, 1915, showed traces of albumin but scanty sediment containing only a few cells; no sugar. Temperature remained normal to subnormal from entrance to January 9 when it suddenly became a swinging septic temperature ranging from normal to 102. Blood cultures were negative, white count never above 9000. Renal function phthalein fell to 15 per cent for two hours. Death attributed clinically to acidosis and terminal infection. *Clinical diagnosis:* diabetes mellitus. Terminal infection.

Autopsy 9¾ hours post-mortem. *Anatomical diagnosis:* diabetes mellitus. Lobar pneumonia, acute pleuritis with effusion, arteriosclerosis, fibromata of uterus, chronic peritonitis and chronic salpingitis, chronic interstitial hepatitis, chronic interstitial pneumonitis, nephritis papillaris mycotica, colon bacillus and streptococcus septicæmia.

Kidneys (Fig. 1, frontispiece). Combined weight 500 grams. Organs are enlarged. Capsules strip easily leaving a fairly smooth dark brownish surface generally mottled with small brownish areas dotted over which are numerous grayish points. The surface of one kidney shows in two places small, pale yellowish white areas 3 to 5 millimeters across. On section the tissue is of increased consistence and shows in the regions of nearly all the pyramids of one kidney and in many pyramids of the other numerous pale yellowish, necrotic, homogeneous, rather firm masses of various size and shape, some of them measuring only a few millimeters across, and others occupying the entire pyramid. As a rule the masses reach to within 3 or 4 millimeters of the cortex although in two places there are slender prolongations of the masses through the cortex to the surface where they appear as the two pale yellowish areas previously mentioned. Margins of these masses in the pyramidal region are slightly serrated and the mass extends to the tip of the pyramid. The tissue bordering the mass is purplish black and homogeneous. From this blackish area dark lines extend in places up through the cortex and are in relation with the blackish areas mentioned as present on the surface. The cut surface of the cortex shows generally a pale brownish to dark brownish background mottled in places with the blackish areas mentioned. The kidney markings are visible. Pelves and ureters negative. Bladder negative.

Bacteriological report. Culture from heartblood, growth of colon bacilli and streptococci; spleen, colon bacilli; kidney tissue, colon bacilli. *Microscopic* sections show on the surface of the cortex, in the regions previously mentioned, mottling, rare infiltration of the interstitial tissue with polynuclear leucocytes and lymphocytes. Extending from these areas in the interstitial tissue between the tubules are lines of similar infiltration extending down to meet the areas of necrosis. The glomeruli are normal, the tubular epithelium of the tubules of the cortical region is for the most part unchanged. In some of the convoluted tubules are masses of desquamating epithelial cells and leucocytes (Fig. 2). In many cases these tubules and their contents appear to form the centers of abscesses surrounded by extensive polynuclear infiltration of the interstitial tissues. The blood-vessels throughout the cortex are much engorged. In the region of the distal convoluted tubules and the bases of the pyramids there is an extensive suppurative process extending transversely across the base of the pyramid, in some instances completely separating it from the cortical tissue. This area corresponds with the previously mentioned purplish black area seen in gross section (Fig. 1). There is complete transverse necrosis of all structures including blood-vessels, tubules, and interstitial tissue at the level of the bases of the pyramids (Figs. 3 and 4). The blood-vessels are often found ruptured with liberation of blood corpuscles into the necrotic area and there is profuse infiltration of polynuclear leucocytes, fragments of renal epithelium, and red blood-cells. The necrotic tips of the pyramids previously mentioned show a homogeneous smooth structure with necrosis as well as fragmentation of nuclei and loss of cell outline without any evidence of infiltration (Fig. 5). The blood-vessels of the pyramids are empty. The lumina of the straight tubules are filled with masses of detritus. In some areas in which the necrotic process is not so complete the contents of the tubule is the center of abscess formation (Fig. 6). The cells of the tubule, containing the masses of detritus, and the interstitial tissue as well as the neighboring tubules show a narrow zone of necrosis outside of which is an extensive infiltration of polynuclear cells.

Sections stained for bacteria show very rarely a short chain of streptococci in the blood stream and

capillary tufts of the glomeruli. The masses of cells found in the convoluted tubules of the cortex are shown to contain large numbers of bacilli and a few chains of streptococci (Fig. 2). In many places tubules which contain no cell detritus show considerable numbers of bacilli within the epithelial cells. A few streptococci and bacilli are found in the infiltrated interstitial tissues. The necrotic area at the base of the pyramid already described shows an extensive bacterial invasion of bacilli and streptococci but with fragments of tubules loaded with bacteria apparently serving as the center of necrosis. Streptococci are much more numerous in this region than in any other portion of the kidney. The masses of "detritus" in the tubules of the pyramids are seen to consist almost entirely of large masses of bacilli (Fig. 5). Very few streptococci are found in this region.

NOTE.— The explanation of the pathological picture presented in this kidney seems to point toward an early infection with colon bacilli in which the bacilli have been excreted through normal glomeruli. Some have been arrested high in the convoluted tubules, many more in the distal convoluted tubules, while large numbers have reached the straight tubules and some even to the pelvis of the kidney. A subsequent infection with streptococci in which most of the streptococci have also passed the glomerulus seems to have taken place. The streptococci have been arrested in the already damaged distal convoluted tubules and have produced along with the colon bacilli an extensive suppurative process at the bases of the pyramid with resulting complete transverse lesion of all structures at that level. Inasmuch as the blood supply of the pyramid is from above downward from the point of vessel division at the base of the pyramid, the transverse lesions with rupture of blood-vessels at this point has resulted in anæmia and subsequent necrosis of the pyramid. There are but two areas in this kidney in which a question of embolism needs to be considered; namely, the two areas of pyramidal necrosis of the cortex previously described.

CASE 2. *Autopsy* No. 3427. East Medical 967-89. Female, age 21. January 13, 1915. *Admission diagnosis:* pneumonia, arthritis. *Present illness.* No previous urinary difficulties. Normal delivery four days ago following which the patient began to have abdominal pain with chills and fever. *Urine*, acid, very slight trace of albumin, many granular casts, red blood-cells and leucocytes. *Blood culture*, no growth. Culture from cervix showed staphylococci and bacilli, one a fusiform bacillus. Smear from cervix showed many staphylococci and streptococci. Patient died on seventeenth day. *Clinical diagnosis:* Puerperal septicæmia, bronchopneumonia, endocarditis, septic arthritis

Autopsy, 9¾ hours post-mortem. Anatomical diagnosis: Puerperal septicæmia, diphtheritic endometritis, rupture of vagina with necrosis of perivaginal tissue, septic arthritis, diphtheritic colitis, soft spleen with infarcts, pyelitis, nephritis papillaris mycotica, streptococcus septicæmia.

Kidneys, much enlarged. Combined weight 558 grams. Capsules strip leaving a pale brownish red, smooth surface. On section the tissue is swollen but markings are retained. The cortex is not narrowed. The cortices are pale brown red with a slight purplish cast. The pyramids are dark brown, and in the region of the apices many of them show pale yellowish, opaque, smooth, discreet, and confluent streaks. The glomeruli show no definite prominence. The pelves show injection of the blood-vessels with minute reddish spots. The ureters and bladder are normal.

Microscopic examination. Throughout the whole tissue there is marked œdema. The cortical portions of the kidney show normal glomeruli with some congestion of the blood-vessels and the great majority of the cortical tubules free from pus but the epithelium shows cloudy swelling. In one portion of the kidney there is an area of extensive infiltration and necrosis of all renal tissue extending transversely across a portion of one of the pyramids. In this area the tubular epithelium is necrotic, the blood-vessels are ruptured and the portion of the pyramid beyond is anæmic. Above the area of necrosis the blood-vessels are congested. In the remaining pyramids there are fine streaks of polymorphonuclear infiltration extending from the bases of the pyramids toward the apex (Fig. 7). In the least extensive of these processes the lumen of the tubule is seen to contain clumps of bacteria surrounding which is a lozenge-shaped area of necrosis including the epithelium of the tubule and the interstitial tissue on each side, sometimes extending far enough to include the adjacent tubule on each side. Beyond this area is a border of pus-cell infiltration. Occasionally throughout the cortical regions there are a few tubules containing pus-cells.

Bacteriological report. Cultures from the spleen show profuse growth of streptococci and question-bacilli; cultures from the heart blood show profuse growth of streptococcus.

Sections stained for bacteria show a few streptococci and bacilli without attending suppurative processes in the glomeruli and tubules of the cortex. In some instances considerable numbers of these organisms are found in the tubules containing the pus-cells previously described (Fig. 8). In the area of transverse lesion of a portion of a pyramid previously described the tubules at the level of the necrotic area are found in many cases almost completely destroyed, yet the portions of the tubular epithelium remaining present the picture of necrosis due to the presence of a large number of streptococci and a few bacilli within the lumen. Between these remnants of tubules is extensive infiltration with polymorphonuclear leucocytes, fragments of renal epithelium and some free blood. The bacteria found in the whole area of necrosis just described are chiefly situated in the remnants of tubules with a few scattered bacteria among the blood and pus-cells between the tubules. In the anæmic area at the tip of the pyramid just described the blood-vessels are entirely empty. There is no infiltration of the interstitial tissue. The tubules contain large plugs of streptococci and bacilli: the former greatly

predominate. In the small lozenge-shaped areas in the region of the straight tubules previously described the central area, that is the lumen of the tubule, is seen to consist of large numbers of streptococci and a few bacilli. Surrounding this group of bacteria is to be seen necrotic tubular epithelium surrounded by a zone of pus-cells. Among the pus-cells of the periphery bacteria are found with great difficulty. The pelvis of the kidney contains streptococci and bacilli.

CASE 3. *Autopsy* No. 3575. West Surgical 207462. Male, age 22, March 26, 1916. *Admission diagnosis:* Carbuncle of neck. *Present illness.* No previous urinary symptoms. Carbuncle of neck one week's duration. *Operation:* incision of carbuncle followed by secondary operation for cellulitis of neck. Patient died fifth day. Culture from carbuncle, staphylococci. *Urine:* acid, albumin, slightest possible trace, rare epithelial and pus-cell. *Clinical diagnosis:* septicæmia.

Autopsy, 18¼ hours post-mortem. Anatomical diagnosis: Operation wound; carbuncle of neck; abscesses of lungs, myocardium, kidneys, and rectus muscle, small mural thrombus right ventricle, acute pericarditis, peritonitis, soft spleen, staphylococcus septicæmia.

Kidneys. Combined weight 396 grams. Capsules strip easily. Surfaces show at several points minute yellowish spots situated singly and in groups. On section these are seen to be the surfaces of small collections of pus. Usually they arise within the cortex but in many instances they extend down often within the central portion of a pyramid as far as the middle of the pyramid. Markings retained, cortex not narrowed. The pelves, ureters, bladder, and urethra are negative.

Microscopic examination. There is œdema with some few areas of acute degeneration throughout the otherwise normal kidney tissue. Numerous sections show the presence of abscesses, mostly in the cortex (Figs. 9, 10, and 11); some in the pyramids and one or two at the tips of the pyramids (Fig. 12). In none of these is there evidence of embolism. The majority of the abscesses of the cortex appear to take origin in glomeruli. The abscess is surrounded by a generous polynuclear infiltration. In most instances the abscess is situated a few millimeters below the surface (Fig. 9). In these instances the tubules leading down into the kidney substance are seen filled with polymorphonuclear leucocytes and surrounded by considerable polynuclear infiltration of the interstitial tissue (Fig. 10). These tubules often lead downward to a second and even third abscess apparently of more recent origin than the one near the surface (Fig. 11). These secondary abscesses show the tubules both above and below them to be filled with polymorphonuclear leucocytes to a considerable distance from the abscess. In one instance a third abscess was found located just beneath the mucosa of the pelvis in the tip of the pyramid and showing a fine line of interstitial pus-cell infiltration connecting it with the overlying two abscesses (Fig. 12). A noteworthy observation found with constancy is that where an abscess is situated a few millimeters below the surface of the kidney, the tubules above, although they may be surrounded by pus-cell infiltration, do not contain pus (Fig. 9), while those tubules below the abscess contain considerable pus (Fig. 10).

Bacteriological report. Cultures from the heart blood, operation wound, abscess of the rectus muscle, and fluid from the peritoneal cavity show profuse growth of staphylococcus albus.

Sections stained for bacteria show only staphylococci. These are found in large masses within the abscesses, are almost universally found within the tubules containing pus, are occasionally found in apparently undamaged tubules immediately beneath abscesses, and are found in large plugs apparently arrested within the tubules at the tips of the pyramid. The pelvis contains a considerable number of staphylococci.

2. THE LESIONS PRODUCED BY PYOGENIC ORGANISMS DIFFER IN ESSENTIAL PARTICULARS AND ARE DISTINGUISHABLE FROM THOSE PRODUCED BY NON-PYOGENIC ORGANISMS

In much of the literature of renal infections one must inevitably infer that the authors believe that no definite distinction can be drawn between lesions produced by different types of bacteria. Thus Mallory in his *Principles of Pathological Histology*, p. 573, says:

> The lesions produced by a number of organisms may closely resemble one another. On this account an etiological classification is ordinarily carried out with only a few organisms, such as the tubercle bacillus and treponema pallidum.

Following the same idea he says somewhat later:

> Infectious agents which most commonly produce lesions of the kidney are the staphylococcus aureus, the streptococcus pyogenes, the bacillus coli, and the tubercle bacillus. Other organisms which occur less commonly are micrococcus lanceolatus, the bacillus mucosus capsulatus, actinomyces, and treponema pallidum.

Thomson Walker has this to say upon the subject of the bacteriology of renal infections:

> The bacillus coli communis is the most common cause of renal infection, occurring in 75 per cent of cases. The next most frequent are the staphylococcus (especially the aureus), the streptococcus, the proteus of Hauser, and the bacillus pyocyaneus.

A little later, under the heading of "Pyelitis of Pregnancy" he says:

> The bacteriology is similar to that of other renal infections.

In contradistinction to these views, we believe that the lesions produced by the cocci and pyogenic bacilli (the pyogenic group) differ essentially from the lesions produced by non-suppurative organisms chiefly the colon-typhoid group.

3. THE LESIONS PRODUCED BY THE PYOGENIC GROUP

These lesions consist of perinephritic abscess, capsular abscess, capsulitis, cortical abscess, septic infarct and diffuse suppuration. In support of this proposition we submit cases 4 to 28 inclusive:

CASE 4. *Specimen No.* 15, 3–39. West Surgical 937–273. Male, age 45, February 26, 1915. *Admission diagnosis:* Stone in right kidney. *Present illness.* No previous bladder symptoms. Three months ago sudden sharp non-radiating pain in right flank accompanied by nausea and vomiting, with temperature which has continued. He has had some hæmaturia. *Physical examination* shows much spasm and enlarged kidney on right. *Urine at admission*, acid, very slight trace of albumin, many leucocytes, rare red blood-corpuscle. *Cystoscopy*, bladder normal, right kidney infected with staphylococci, renal pelvis not abnormal, which excludes tumor and pyonephrosis.

Diagnosis: staphylococcus infection of right kidney, nephrectomy advised. *X-ray* showed right kidney enlarged, no evidence of stone. *Culture* from urine showed staphylococcus pyogenes aureus. *Operation:* nephrectomy. Kidney found enlarged, covered by a thick fibrous capsule which was œdematous. Capsule, which was 1 to 2 centimeters thick, stripped off with difficulty and several small abscesses evacuated in the process. The kidney was large, whitish, with red-yellow mottling. The pelvis was not dilated; the ureter was normal. Uneventful recovery.

Pathological report. A somewhat enlarged kidney with adherent perirenal fat. Sections show multiple abscesses scattered throughout the cortex and medulla. Intervening tissue opaque. Examination shows extensive infiltration with round cells with here and there abscess formation. Tubular epithelium is swollen. Multiple abscesses present.

Sections stained for bacteria. Show many staphylococci in clumps in the abscesses. A few bacteria are to be seen in the areas of infiltration above described. These areas show subacute infectious processes with obliteration of the tubules to such an extent that the bacteria outside abscesses cannot be located with accuracy. Cocci are present in the pelvis without any evidence of pyelitis.

CASE 5. Autopsy No. 232. West Surgical 331–111. Male, age 20, March 6, 1898. *Present illness.* Septic finger, two weeks duration. *Operation:* incision and drainage. *Temperature* at admission, 104.8. Pus from hand showed staphylococcus pyogenes aureus and bacilli. Patient died on fifth day with symptoms of pneumonia. *Clinical diagnosis:* Septic hand, metastatic pneumonia.

Autopsy, 5 hours post-mortem. Anatomical diagnosis: Gangrene of finger, phlegmon of arm, secondary abscess sternoclavicular articulation and subpubic connective tissue, abscesses of lungs and kidneys, acute hyperplasia of spleen.

Kidneys, considerably enlarged. Capsules strip easily revealing numerous small abscesses in the substance of the kidney. On section similar abscesses are seen scattered irregularly through the cortex and less abundantly in the pyramids. Cortical tissues opaque and swollen.

Bacteriological report. Abscesses of kidney and lung and heart blood show growths of staphylococcus pyogenes aureus.

Sections stained for bacteria. Numerous staphylococci in the abscesses, some few in the blood stream. The majority of glomeruli and tubules are apparently undamaged. Many abscesses in the pyramids appear from the location of bacteria to take origin from the lumen of the tubules. Many epithelial cells are filled with phagocyted cocci. In one or two areas abscesses appear to take origin in the interstitial tissue in one of which an embolus can be demonstrated.

CASE 6. Autopsy No. 2492. West Surgical 647–275. Male, age 34, November 23, 1909. *Present illness.* Admitted with diagnosis of tumor of the bladder with cystitis. Temperature 101°. *Urine*, neutral reaction, albumin ¼ per cent; sediment much blood. Patient unable to void on account of hæmaturia, placed on constant drainage. Amount of urine extremely small. Patient died without operation on the twentieth day.

Clinical diagnosis. Tuberculosis of the prostate (?), uræmia.

Autopsy, 11½ hours post-mortem. Anatomical diagnosis: Squamous cell carcinoma of bladder with bone formation in the stroma, suppurative nephritis of right kidney, occlusion of ureters in bladder-wall, atrophy of right kidney with pelvic dilation, compensatory hypertrophy of left kidney, dilation of ureters.

Kidneys. Right kidney weighs 109 grams, left 268 grams. Capsules strip easily. Markings of the left kidney are retained; right kidney not clearly defined. Cortex of right kidney is narrowed, that of left is normal. The pelvis of the right kidney is dilated leaving only a small amount of kidney tissue. Scattered throughout the kidney tissue are numerous small dark red hæmorrhagic areas. The left kidney shows a slightly dilated pelvis. Both ureters are markedly dilated, the right filled with blood.

Probe cannot be made to pass through the urethrovesical orifice on either side. The bladder-wall is markedly thickened especially on the right where there is a large grayish white mass extending beyond the median line and infiltrating the bladder-wall.

Microscopic examination. Right kidney shows much fibroid atrophy of the tubules and glomeruli and infiltration with lymphocytes. Here and there small abscesses are present. Left kidney shows œdema. Here and there a small focus of atrophy with lymphocytic infiltration is seen.

Bacteriological report. Cultures from the heart blood show no growth. *Sections stained for bacteria.* The sections preserved from this autopsy show no true abscesses but only low grade kidney change. Large cocci are found in the glomeruli of the tubules and scattered throughout the interstitial tissue, may be post-mortem invasion.

CASE 7. Autopsy No. 2364. South Surgical 179–203. Female, age 1 year 10 months, May 7, 1909. *Present illness.* Comes in for tumor of the left kidney. For past two weeks has had hæmaturia followed by fever. *Temperature* at entrance, 102.

Second day after admission to the hospital, while eating, child suddenly uttered a piercing shriek, turned cyanotic, and died. *Clinical diagnosis:* Sarcoma of kidney, pulmonary ebolism.

Autopsy 4 hours post-mortem. Anatomical diagnosis: Adenosarcoma of the left kidney with metastasis in the abdominal lymph-nodes, suppurative nephritis, pulmonary embolism.

Kidney. The left ureter when followed upward opens into an irregular yellow mass which contains considerable broken down creamy white material. Just beyond the opening of the ureter there is a small strip of tissue showing markings with pyramids and glomeruli. In one place there is a streak of yellow running through what appears to be a pyramid. This kidney tissue is continuous with and passes over into a large tumor mass. The ureters and bladder are normal.

Microscopical examination. Kidney shows the tumor to consist of adenosarcoma of the kidney. In one section in some of the renal tissue are follicles of lymphoid tissue. In the right kidney there are foci of suppurative nephritis.

Bacteriological report. Culture from the heart blood shows no growth. *Sections stained for bacteria.* In three places in the kidney small arteries are found plugged with hyaline masses containing a few partly disintegrated cells and large numbers of staphylococci. In one instance there is evidence of some suppuration about the plug while in the other two there is no evidence of tissue change.

CASE 8. Autopsy No. 623. South Surgical 48–148. Male, age 15. November 8, 1900. *Admission diagnosis:* Septic arm. *Present illness.* Five months ago patient had felon of finger which is now healed. Two days ago, without apparent cause, the right elbow became swollen and painful. *Temperature* 102. *Operation.* Incision and drainage of elbow-joint. Pus showed staphylococcus pyogenes aureus. Died ninth day. *Urine examination* not recorded. *Diagnosis:* Septicæmia, osteomyelitis.

Autopsy 19½ hours post-mortem. Anatomical diagnosis: Operation wound of right arm with osteomyelitis of the humerus; multiple abscesses of the lungs, serofibrinous pericarditis, abscesses of the myocardium, abscesses of the prostate, suppurative nephritis, acute degeneration of the liver, acute hyperplasia of spleen, ecchymosis in the mucosa of the stomach, tuberculosis of the left epididymis and testis, staphylococcus septicæmia.

Kidney. At several points in each kidney just beneath the capsule are yellowish purulent foci the size of a pinhead.

Bacteriological report. Cultures from the heart blood show staphylococcus pyogenes aureus. Liver, spleen, lung, and pericardium show the same.

Microscopic examination. The cells of the tubules of the cortex show some swelling and granulation. There are a few small abscesses apparently originating in glomeruli. One or two of the convoluted tubules show beginning abscess formation.

Sections stained for bacteria show large numbers of staphylococci in the abscesses. Staphylococci are found in the tufts of glomeruli, capsule of Bowman, tubules, and a few in the lymph-spaces. Small abscesses in the lower tubules show the cocci mostly confined to the lumen of the tubule.

CASE 9. Autopsy No. 2784. East Surgical 712–291. Male, age 49. January 28, 1911. *Present illness.* Uræmia, hæmaturia, and pyuria at entrance to hospital. *Urine examination* not recorded. *Temperature* 99. White blood count 18,000. Cystoscopy showed inoperable carcinoma of the bladder. Patient died the following day. *Clinical diagnosis:* Uræmia, carcinoma of the bladder, infected kidneys.

Autopsy 6¾ hours post-mortem. Anatomical diagnosis: Carcinoma of the bladder, pyonephrosis, suppurative nephritis, perinephritic abscess, soft spleen.

Kidneys. Right kidney weighs 260 grams. The perinephric tissue is markedly thickened and shows extensive infiltration with pus. The capsule strips with difficulty leaving an irregular surface dotted over with numerous minute yellow points which yield pus. The cortex is 5 to 8 millimeters. On section the surfaces show minute collections of pus situated mainly in the cortical region. The pelvis and ureter are slightly dilated. The right ureter is somewhat occluded by a new-growth of tissue in the bladder. The left kidney weighs 193 grams. The perinephric tissue is greatly thickened and shows extensive infiltration with pus. The capsule strips leaving a lumpy surface dotted over with abscesses. The cortex measures 5 to 6 millimeters. Section surfaces show minute collections of pus mainly in the cortical region. In some places the tubules are dilated. The calices show yellow necrotic flakes.

The left ureter is dilated and partly occluded by new-growth of bladder. The bladder mucosa is inflamed. The prostate is not enlarged. The upper part of the organ is involved in a new-growth of the bladder-wall which extends down onto the posterior portion of the prostate.

Microscopic examination of the kidney is not recorded.

Bacteriological report. Culture from heart blood. No growth. *Sections stained for bacteria* show no bacteria other than staphylococci. They are found in the lymph-spaces and within the lumina of tubules, sometimes phagocyted in the epithelium of the tubules, and diffusely in the abscesses. No bacilli are seen in the kidney tissue. There are a few lying free in the pelvis.

CASE 10. Autopsy No. 2381. South Surgical 182-189. Male, age 24. June 12, 1909. *Present illness.* Injury to right forearm eight days ago. Three days ago became delirious. Arm much swollen. *Blood cultures* showed staphylococcus pyogenes aureus; cultures from arm, staphylococcus aureus. *Urine examination,* not recorded. *White blood count,* 17,200. *Temperature,* 103–108. Died second day after entrance.

Clinical diagnosis: Septicæmia, septic wound.

Autopsy, 17⅔ hours post-mortem. Anatomical diagnosis: Septic wound of forearm, right, multiple abscess of myocardium, liver, kidneys, brain, acute splenic tumor.

Kidneys. Combined weight 312 grams. Capsules free. The surface is marked by numerous round and oval abscesses surrounded by reddish zones. The stellate veins are injected. On section cortex is of normal thickness. Both cortex and medulla show numerous fairly sharply circumscribed round spots many of them surrounded by reddish zones. Both kidneys present practically the same picture. The bladder shows injected mucosa and dark colored areas. Pelves and ureters are normal. *No microscopic examination* or *bacteriological report* is recorded. *Sections stained for bacteria* show large numbers of staphylococci found only within the small abscesses.

CASE 11. Surgical Case No. 712–90. South Surgical 157–307. Male, age 28, December 24, 1907. *Past history.* Gonorrhœal infection one year ago.

Present illness. For three weeks has had hæmaturia and pyuria with dull aching pain in the right kidney. No stricture.

Urine, acid, large trace of albumin, pus and blood. *Temperature,* 100. *Operation,* nephrectomy with drainage, uneventful recovery. *Clinical diagnosis:* Focal suppurative nephritis.

Pathological report. Large kidney fibrous at one end with abscess. Several small purulent foci scattered through the substance. *Sections stained for bacteria* showed only staphylococci present; these are found only in abscesses.

CASE 12. Autopsy No. 138. East Surgical vol. 328, p. 77, 177, 176. Male, age 62, July 9, 1897. *Diagnosis:* Carcinoma pancreas. *Past history:* Eight years ago had pain in right lumbar region referred to groin and testes. *Present illness.* Admitted to the hospital for gastric symptoms. *Urine examination,* on admission was negative save for slight trace of albumin, occasional pus-cell, no casts. *Operation:* Exploratory laparotomy for carcinoma of pancreas. Operation wound became septic. Small abscesses developed about stitch holes with miliary abscesses in deep fat throughout the length of the wound. Continued temperature after operation ranging from 100 to 103°. After one month from operation patient's wound gradually became cleaner showing good granulations. The patient, however, continued to lose ground, and became progressively weaker. The temperature again rose. He developed phlebitis in right leg, spasticity in right hand and arm, and swelling of left parotid region. Died on the thirty-eighth day.

Autopsy 7 hours post-mortem. Anatomical diagnosis: Carcinoma pancreas and adjacent glands involvement of the liver and glands along the abdominal aorta and iliac vessels; abscess in tissue of the abdominal wall; acute purulent phlebitis; œdema lungs with abscesses of upper right lobe and lower left lobe; degeneration of the kidneys with subacute abscess formation.

Kidneys, enlarged. Combined weight 544 grams. Cortices 5 to 7 millimeters. Capsules strip with a few adhesions. Surfaces yellowish red with thickly sown pinhead to bean sized areas, yielding on section white semi-fluid pus. These areas are more numerous in the right kidney. On section the pelvis is not remarkable. The markings are indistinct in places. Scattered through the tissue are small yellowish areas and patches mostly in or near the cortex. In the left kidney, but also showing everywhere in the right kidney, are yellowish streaks extending down from the cortex into the pyramids. The *bladder* shows nothing abnormal.

Bacteriological report. Cultures from the heart blood, liver, kidneys, pleura, spleen, and pus in the peritoneal cavity show staphylococcus pyogenes aureus. Pus from the peritoneal cavity shows in addition bacillus coli communis.

Microscopic examination shows a few scattered darkly stained areas equally distributed through the cortex and pyramids. These areas are on the average the size of a pinhead. In the pyramids they seem elongated in the direction of the tubules. On examination, they are seen to consist of numerous pus-cells closely packed together in the midst of which remains of kidney structure are rather faintly indicated. Interspersed among the pus are small granulation tissue-cells. This condition would indicate that the process had lasted for some time. These areas are abscesses in the process of healing. Considerable granular detritus and colorless ring-like bodies lie in the lumen of the tubules. No emboli are made out.

Sections stained for bacteria. Right kidney shows in one corner of the section several small abscesses

two or three times the size of a glomerulus, all of which seem to take origin from glomeruli or the neighboring proximal convoluted tubules (Fig. 13). In the centers of these areas are large masses of staphylococci. There are many new connective-tissue cells. Surrounding the abscess areas, there is a diffuse infiltration with new connective-tissue cells and polynuclear leucocytes. Many of the tubules leading toward the pelvis from these areas show plugs of pus and desquamated epithelial cells thickly studded with phagocyted bacteria. In the region of the distal convoluted tubules such bacterial plugs are seen to form the centers of small abscesses. Throughout the remainder of the section the tissue is for the most part unchanged. In some areas, however, there is considerable desquamation of the epithelium of the tubuli contorti. In all such portions of the sections the blood-vessels are seen to contain large numbers of staphylococci most of which are within the leucocytes (Fig. 14). In several areas the capillary entering the glomerulus and the tuft of the glomerulus contain large numbers of staphylococci (Fig. 15). In the glomeruli the staphylococci are seen lying in the capillaries and also free in the capsule of Bowman (Fig. 16). In none of these glomeruli was there any extravasation of blood into the capsule indicating a rupture of the capillary. In one of the glomeruli, in which a fortunate plane of section shows a considerable portion of the first part of the tubule, bacteria are seen not only lying in the capsule of Bowman but entering the tubule (Fig. 17). In all portions of the convoluted tubules considerable numbers of bacteria are seen in the tubules but mostly contained *within the epithelial cells* (Figs. 18 and 19). In the straight collecting tubules bacteria seem always to lie in the lumina of tubules. In the pelvis, staphylococci and bacilli are found. The pelvic mucosa looks normal. Some few bacteria are to be found in the interstitial tissue, most of them lying in the lymph-spaces.

NOTE.— This kidney seems to indicate that there has been two general infections. In the first there was considerable abscess formation resulting, which had begun to heal. There seems in addition to have been a severe septicæmia, many bacteria from which are seen in the process of excretion through undamaged glomeruli.

CASE 13. Autopsy No. 322. West Medical 510–162. Male, age 69, September 19, 1898. *Present illness.* Has been sick for two weeks with dyspnœa as chief complaint. *Physical examination* shows nothing of interest save high temperature and abscess back or neck. *White blood count,* 82,000. *Urine,* acid, cloudy, albumin, slight trace; sediment, few hyaline casts, blood, leucocytes. Died fourth day. *Discharge diagnosis:* Septicæmia. Abscess of neck.

Autopsy 6 hours post-mortem. Anatomical diagnosis: Phlegmon right shoulder, multiple abscesses lungs, suppurative nephritis with infarctions, acute hyperplasia spleen, decubitus.

Kidneys. Capsules free, cortex of normal width, markings retained. Here and there in the pyramids and in the cortex are a few grey, opaque pinhead sized points. In one kidney there is a large wedge-shaped area extending from the base of a pyramid upward to the capsule. The tissue is opaque, pale, and the outline is marked by a grey zone. Pelves, ureters, and bladder normal.

Microscopic examination. Micrococci seen in the abscesses. In one or two instances plugs of micrococci are found in the small vessels. Cultures from the carbuncle in the back show staphylococcus pyogenes aureus. Heart blood, spleen, liver, and kidney the same.

Sections stained for bacteria. One area, the small pyramidal area of suppuration, apparently takes origin from a bacterial embolus in a small artery. In other instances the glomeruli are clearly the seat of abscess formation, while in still others plugs of bacteria are found in the lumina of tubules surrounding which there is a narrow area of necrosis of epithelium, outside of which is infiltration with polynuclear leucocytes. In still other areas staphylococci singly or in small groups are found in the arterioles entering glomeruli. In the glomeruli they are found within the capillaries and in the tubules, in many cases phagocyted within epithelial cells of the convoluted portion. In some instances bacteria are seen within epithelial cells in apparently normal tubules.

CASE 14. Autopsy No. 2597. West Medical 762–47. Male, age 65, May 2, 1910. *Present illness.* Eleven months painful and difficult urination; brown, cloudy urine. Four months severe gastric symptoms suggestive of cancer. *Temperature* normal at entrance. *Urine,* alkaline, albumin slight trace, occasional cast. No urine culture recorded.

Four days later without apparent reason patient began to have hæmaturia with small amount of pus, accompanied by rise of temperature to 105.5° and died the third day following.

Autopsy 18 hours post-mortem.

Anatomical diagnosis. Adenocarcinoma of stomach, multiple carcinoma of small intestines, chronic nephritis, suppurative nephritis of right kidney, renal and ureteral dilatation, arteriosclerosis, cholelithiasis, small fibroma of bladder-wall.

Kidneys. Combined weight 200 grams. Left kidney capsule strips but is somewhat adherent. Cortex is 1 to 2 millimeters in width. Left ureter is slightly dilated along its entire course but opens freely into the bladder. The mucosa is negative. Right kidney capsule strips with some fine adhesions. The granular surface is dotted over in many places with minute yellow spots. On section the tissue is firm, cortex extremely narrowed. The yellow spots described as present on the surface project down into the kidney tissue as minute, small, reddish irregular areas. The pelvis is slightly dilated. The mucosa is smooth. The right ureter is dilated; its mucosa is smooth; and opens

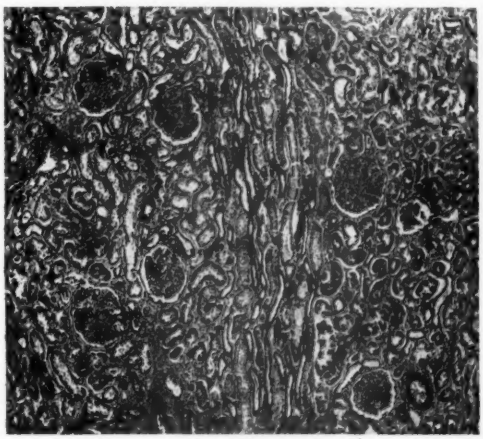


Fig. A. Typical microscopic field from the kidney of patient known to have had colon pyelonephritis of hæmatogenous origin attended by a marked fall in phthalein output and subsequent return to normal function. The kidney is essentially normal. Photo by L. S. Brown x 45.

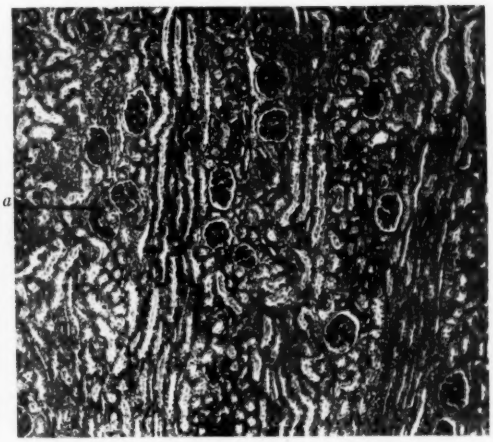


Fig. B. Typical field from rabbit kidney through which paratyphoid bacillus alpha has been passed in large numbers on three occasions. Save for one changed glomerulus at (*a*) the kidney is normal. Photo by L. S. Brown, x 45.

freely into the bladder. The bladder mucosa is not remarkable save that in one area there is a round minute pedunculated mass springing from the mucosa. The prostate is negative.

Microscopic examination. There is marked fibroid atrophy of the renal tissue with much arteriosclerosis, extensive suppuration, and destruction of renal tissue in the surrounding areas.

Bacteriological report. Cultures from spleen show question of bacilli. *Sections stained for bacteria* show only staphylococci. These are found in abscesses and a few in the tubules within the protoplasm of a clump of pus-cells.

CASE 15. Autopsy No. 2998. West Medical 814–201. Male, age 64, February 7, 1912. *Past history:* Boils on the shoulder three years ago. For six years has had diabetes. *Present illness.* Sore toe of two weeks' duration. Coma. *Physical examination* shows diabetic gangrene. *Temperature* normal. *Urine* contains much free blood and pus, slight trace of albumin, sugar, acetone, and diacetic present. Patient sent to ward where he promptly died. *Clinical diagnosis:* Diabetes, acidosis, coma.

Autopsy. 10¼ hours post-mortem. Anatomical diagnosis: Diabetes, arteriosclerosis, abscess of prostate, amyloid kidneys, gangrene of toe, soft spleen, small abscess of kidney, staphylococcus septicæmia.

Kidneys. Combined weight 540 grams. Capsules strip leaving smooth surface save in one point on the right kidney where there is a collection of fibrinopurulent material which extends into the perinephric fat. The cortices are not narrowed. In the substance of the right kidney a short distance below the collection of pus on the surface there is a small dark red area the central portion of which is soft. The ureters are free. The bladder shows hypertrophy of the trabeculæ and the mucosa of the trigonum shows swelling and dirty reddish discoloration, with here and there minute, yellowish, soft areas. The prostate is slightly enlarged and shows numerous small areas of pus throughout the organ. They are most numerous in the middle lobe and extend up beneath the trigonum. *Cover glass preparations* from the prostatic pus show staphylococcus.

Microscopic examination. Kidneys show amyloid infiltration of the small arteries and glomeruli, œdema with some areas of necrosis and pus-cell infiltration. Sections of the prostate show suppuration and abscess formation.

Bacteriological report. Cultures from the heart blood show many colonies of staphylococci. *Sections stained for bacteria* show staphylococci alone in the small abscess cavity.

CASE 16. Autopsy No. 2262. West Medical 712–95. Female, age 45. November 30, 1908. *Past history:* Negative save for polyuria five years ago at which time diagnosis of diabetes made. *Present illness*, patient comes in for abnormal menstruation. *Urine* acid, no albumin, sugar acetone or diacetic present, moderate amount of pus. Patient put on very strict diabetic diet. Patient continued comfortable except hungry for 15 days at which time she became drowsy, developed a slight cough, and scattered râles in the lungs and died on the seventeenth day. *Clinical diagnosis:* Diabetes, acidosis, endometritis.

Autopsy. 14½ hours post-mortem. Anatomical diagnosis: Glycosuria, tuberculosis of left lung,

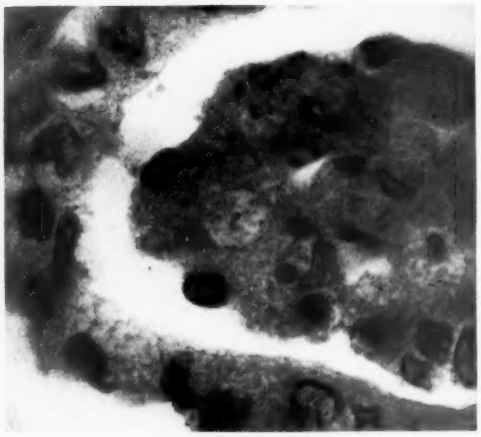


Fig. 2. Proximal convoluted tubule of the cortex filled with desquamated epithelium and containing bacteria.

soft spleen, suppurative nephritis with miliary abscesses of right kidney.

Kidneys. Combined weight 385 grams. Capsules strip easily save over an area of the right kidney where there is a reddened spot 5 millimeters in diameter. This area is dotted with minute abscesses. *Cover glass preparation* from pus is negative for tubercle bacilli. On section the remaining tissue of the kidney is firm, markings are visible, cortex is not narrowed, the pyramids are brownish red and show indefinite minute yellow areas in places. Bladder, ureters and pelves are not remarkable.

Microscopic examination. In two sections of the kidney there are abscesses with suppurative infiltration. There is no tuberculosis.

Bacteriological report. Cultures from the heart blood and spleen show no growth. *Sections stained for bacteria* show some hæmorrhagic glomeruli in which are cocci in very small numbers. An occasional group of cocci can be found in the lumina of tubules low down toward the tips of the pyramids and a few in the pelvis. The sections preserved from this kidney show no abscesses.

CASE 17. Autopsy No. 1828. East Surgical 554–275. Male, of 29. November 25, 1906. *Present illness.* Carbuncle upper lip, five days' duration. Intense œdema, fever. No renal tenderness or masses. *Temperature* 104°. *Urine,* negative (but no sediment done). Patient died third day. *Clinical diagnosis:* Carbuncle of lip, septicæmia.

Autopsy 6 hours post-mortem. Anatomical diagnosis: Carbuncle of lip, multiple abscess of the lung with empyema, suppurative infiltration of the anterior and superior mediastinum, suppurative nephritis, acute hyperplasia of spleen, staphylococcus pyogenes aureus, septicæmia.

Kidneys. Combined weight 360 grams; capsules slightly adherent. There are three or four minute suppurative foci in the kidneys. The cortices are normal in width and the markings retained. The bladder and ureters are not remarkable.

Microscopic examination. There is cloudy swelling of the epithelium of the tubules.

Bacteriological report. Cultures from the heart blood and spleen show staphylococcus pyogenes aureus. *Sections stained for bacteria* show large clumps of staphylococci within the abscesses, none in any other part of the section.

CASE 18. Autopsy No. 1201. South Surgical 91–255. Female, age 43. March 16, 1904. *Present illness.* Recent pneumonia followed by empyema with symptoms of brain abscess of two weeks' duration. *Urine examination* at admission negative; thirteen days later slight trace of albumin, small amount of blood and pus. *Operation.* Exploration of old empyema. Following operation patient became unconscious and general paralysis developed. Patient died thirty-third day. *Clinical diagnosis:* Empyema, brain abscess.

Autopsy. Anatomical diagnosis: Abscess of brain, chronic empyema left with sinus communicating with the splenic flexure of the colon, subdiaphragmatic abscess, ulcer of stomach with secondary carcinoma, abscess of kidney, operation wound.

Kidneys. The kidneys are of normal size; capsule strip. At one point in the surface of one of the kidneys is a small abscess which extends a short distance into the kidney tissue. The bladder and ureters show nothing abnormal.

Microscopic examination. Kidney sections show rather extensive degeneration of the renal elements.

Bacteriological report. Cover glass preparations from the pus of the brain abscess show leucocytes,

Fig. 3. Microphotograph of area of complete transverse lesion (a — a) at base of a pyramid. Below is shown necrotic pyramid. b — b Congested blood-vessels.

staphylococci, streptococci, and bacilli. *Cultures* from the heart blood show no growth; liver shows many colonies of colon-like bacilli and a few streptococci; spleen shows slight growth of colon-like bacilli. *Sections stained for bacteria* show clumps of staphylococci in abscesses, none found in the tubules or pelvis.

CASE 19. Autopsy No. 1003. West Surgical 441–45. Female, age 53, June 15, 1903. *Past history* negative as to genito-urinary tract. *Present illness.* Five years ago gall-stone symptoms, *urine* examination on admission negative. *Operation,* cholecystotomy with drainage of common duct. Slight sepsis of wound occurred. During convalescence swelling of right parotid gland which was later incised. Patient died on the thirty-fourth day. *Clinical diagnosis:* Gall-stones and pyæmia.

Autopsy 14½ hours post-mortem. Anatomical diagnosis: Cholecystectomy with open bile-duct, subcutaneous abscess of the walls of the wound, phlegmon of neck, abscesses of kidneys, septicæmia staphylococcus pyogenes aureus.

Kidneys. Weight is not mentioned; capsules strip easily. In two or three places in each kidney the surface shows several small abscesses which extend a short distance into the kidney substance. *Cover glass preparations* from the pus of these abscesses show leucocytes and staphylococci. Ureters and bladder show nothing worthy of note.

Microscopic examination. Sections from the kidneys show abscesses.

Bacteriological report. Cultures from the heart, liver, spleen, skin abscesses, and kidney abscesses show growth of staphylococcus pyogenes aureus. *Sections stained for bacteria.* Abscess cavities show large clumps of staphylococci, no other bacteria.

CASE 20. Autopsy No. 1039. West Medical 584–40. Male, age 38, March 15, 1902. *Present illness.* Seven weeks ago began to feel poorly, slight gastric symptoms, restlessness at night. Two weeks later gave up work. Still later he began to develop pain and local areas of soreness in the left arm. Temperature at entrance 100° and continued as a high septic temperature. *Physical examination.* Large abscess of right shoulder, another over sacrum. On back and extremities numerous small semifluent abscesses. Pus from abscesses showed staphylococcus pyogenes aureus. *White blood count* 26,000. *Urine,* acid; albumin, slightest possible trace; sediment, rare casts but some with pus-cells adherent; few pus-cells, much epithelium. Patient continued with high fever until death on the fifth day. *Clinical diagnosis:* Pyæmia, multiple abscesses.

Autopsy 39½ hours post-mortem. Anatomical diagnosis: Multiple abscesses of the liver, thrombosis of hepatic vein, multiple abscesses of lungs, kidneys, and subcutaneous tissue of extremities and trunk, hyperplasia of spleen, purulent otitis media, septicæmia, staphylococcus pyogenes aureus.

Kidneys. Combined weight 416 grams. Capsules free. Scattered throughout the substance of each kidney are several small abscesses containing pus. Some of these are arranged in more or less confluent groups. Cortices of normal width with markings retained. Bladder, prostate and ureters normal.

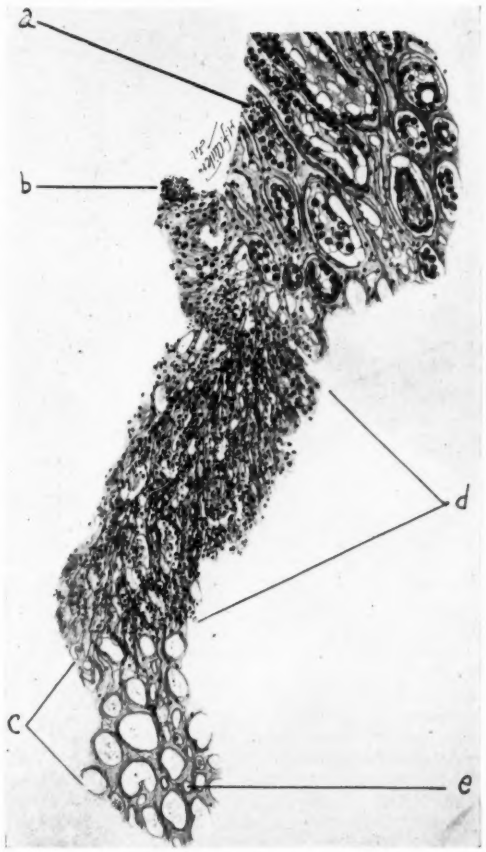


Fig. 4. Drawing through area of kidney including cortex, zone of suppuration, and portion of necrotic papilla. *a*, Fairly normal cortical tubules; *b*, congested vein; *c*, anæmic necrotic area of pyramid *a*, Fig. 1; *d*, area of transverse suppurative lesion (purplish area of Fig. 1 marked *b*); *e*, empty blood-vessels of anæmic papilla.

Microscopic examination. Aside from the abscesses, the renal tissue is not remarkable.

Bacteriological report. Cultures from the heart, liver, and spleen, abscesses of the right kidney, hip and left ankle show profuse growth of staphylococcus pyogenes aureus. *Cover glass preparations* from these abscesses show staphylococci but no other bacteria. *Sections stained for bacteria.* Abscess cavities contain clumps of staphylococci, no other organisms.

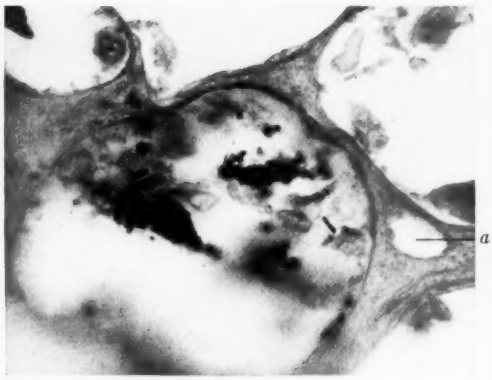


Fig. 5. Microphotograph of a necrotic anæmic papilla showing necrosis of interstitial tissue and epithelium of the tubules with fragmentation of nuclei and loss of cell outline. The lumen of one tubule is seen filled with large clumps of bacteria (almost entirely colon bacilli). Empty blood-vessels seen at *a*. Bacilli treated with 40 per cent formalin to cause them to retain the gram-stain for photographic purposes. Photo by L. S. Brown, x 1500.

Fig. 6. Microphotograph showing destruction of a tubule by bacteria contained within its lumen. Remnant of tubule seen to the left. Bacteria are chiefly streptococci. Photo by L. S. Brown, x 1500.

CASE 21. Autopsy No. 986. East Medical 573–138. Female, age 52, December 22, 1902. *Past history*, negative. *Present illness*. Eight days ago symptoms of acute infection with vomiting, loss of appetite, shortness of breath, and urinary incontinence. *Physical examination*. Considerable fluid in abdomen, evidence of fluid in both chests. Question of tumor mass in abdomen. Temperature normal and remained so. White blood count 62,000. *Urine*, acid, slight trace of albumin, moderate amount of pus. Abdominal fluid, exudate cells, polymorphonuclear leucocytes. A few cocci in abdominal fluid. Patient died suddenly on third day. *Diagnosis:* Ovarian cyst, septicæmia and pyæmia.

Autopsy, 6 hours post-mortem. Anatomical diagnosis: Cystomata of the ovaries with suppuration and gangrene, compression and dilatation of the right ureter, suppurative nephritis of the right kidney.

Kidneys. Left kidney somewhat larger than right. Capsule strips. Cortex narrow markings retained. On the surface of the right kidney are a number of whitish slightly elevated areas which on section show purulent material. These areas are not sharply outlined from the surrounding renal tissue and show some tendency to extend in the form of streaks into the cortex.

Microscopic examination. On section kidney shows an area of injected renal tissue infiltrated with polynuclear leucocytes. The renal tubules appear to be disintegrated.

Bacteriological report. Cultures from the heart and spleen no growth; from liver two colonies of bacillus coli communis. Peritoneal exudate shows bacillus coli communis, bacillus aerogenous capsulatus and staphylococci. *Section stained for bacteria* show a few staphylococci in one of the tubules. There are no abscesses in the section preserved.

CASE 22. Autopsy No. 813. South Surgical 60–64. Male, age 31. January 6, 1902.

Past history. Gonorrhœa twice. *Present illness*. Appendix symptoms three weeks' duration with abscess at time of entrance to hospital. *Urine* at entrance showed slight trace of albumin; sediment showed pus and very many casts, some with pus-cells adherent. Septic temperature ranging from 100 to 104°. White blood count 43,000. Free pus in the abdomen, cultures from which showed staphylococcus pyogenes aureus. Patient died on the nineteenth day after admission. *Clinical diagnosis:* Appendix abscess, septicæmia.

Autopsy 13¾ hours post-mortem. Anatomical diagnosis: Gangrenous appendicitis with abscess formation with perforation and gangrene of cæcum, suppurative phlebitis ileocolic and superior mesenteric veins, suppurative thrombophlebitis portal vein, multiple abscess liver, abscess right kidney, laparotomy wound, acute hyperplasia spleen, streptococcus septicæmia.

Kidneys. Combined weight 203 grams, capsules strip. Cortex measures 6 millimeters. The pyramids are dark reddish in color. The substance of the right kidney in the pyramidal portion discloses on section a small collection of pus. No areas of suppuration found in the left kidney. Ureters, bladder, prostate, seminal vesicles, and testes are not remarkable.

Microscopic examination. A fairly large section of the kidney fails to show any lesion worthy of mention.

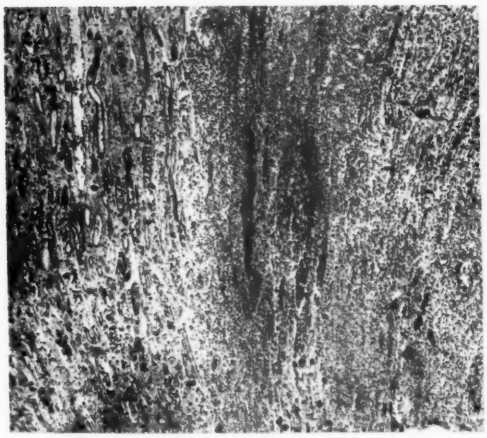


Fig. 7. Lozenge-shaped abscesses in the collecting tubules of a pyramid. The dark masses are streptococci and colon bacilli. The pale area just outside the clumps of bacteria is necrotic epithelium of the tubule. The whole is surrounded by a border of pus-cell infiltration. Photo by L. S. Brown, x 40.

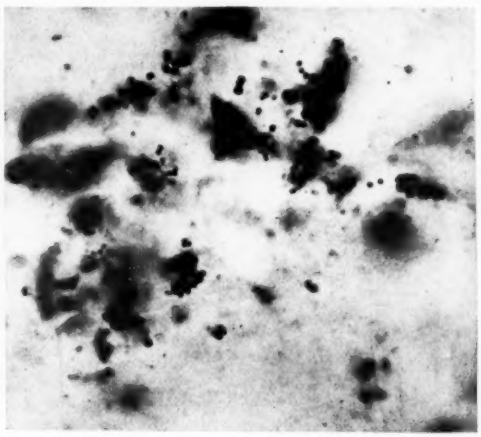


Fig. 8. Streptococci and rare bacilli in center of lozenge-shaped abscess shown in Fig. 7. Note remnants of tubular epithelium and absence of pus-cells in this area which is the remnant of a tubule. Photo by L. S. Brown, x 1500.

Bacteriological report. Liver and spleen show profuse growth of bacilli of the colon group. In the water of condensation are numerous micrococci and a number of streptococci. Cultures from the liver at the time of operation show innumerable colonies of staphylococcus pyogenes aureus. *Sections stained for bacteria.* There are no abscesses in the section preserved. In one of the collections of leucocytes in a tubule a few staphylococci are found, too few to make any estimate as to the nature of the infection.

CASE 23. Autopsy No. 1065. East Surgical 440–269. Male, age 1½ years. May 15, 1903. *Past history.* Infectious diarrhœa at eleven months. *Present illness.* Two days ago fell and bruised forearm. Has had chills and fever since then. *Temperature* 104°. *Urine* not recorded. *Operation.* Incision and drainage of forearm. Culture from forearm showed staphylococcus pyogenes aureus. Death on second day. *Clinical diagnosis:* Septic periostitis, pyæmia.

Autopsy 19½ hours post-mortem. Anatomical diagnosis: septic right forearm; multiple abscesses lungs, kidneys, and myocardium; septicæmia staphylococcus pyogenes aureus.

Kidneys. Combined weight 95 grams. Capsules strip easily. On the surface of both kidneys are a few small yellowish abscesses. *Cover glass preparations* from the purulent material in one of these abscesses show numerous staphylococci; no other bacteria. *Microscopic examination.* The section examined shows a small abscess. *Bacteriological report.* Cultures from the heart show many colonies of staphylococcus pyogenes aureus. Cultures from the liver and spleen show staphylococcus pyogenes aureus and colon-like bacilli. *Sections stained for bacteria.* Staphylococci only are found in the small abscess area. There are no bacilli in the pelvis.

CASE 24. Autopsy No. 1363. East Surgical 504–169. Male, age 64. April 6, 1905. *Present illness.* Recent open fracture of ankle and fracture of ribs. *Urine*, first examination negative; second examination two weeks later, albumin small trace; sediment much pus. Admission temperature, 101°, rose to 103–104°, maintained until death on twenty-fourth day. Streptococci in wound. *Clinical diagnosis:* Compound fracture of ankle, streptococcus wound, streptococcus septicæmia.

Autopsy 18½ hours post-mortem. Anatomical diagnosis: Compound comminuted fracture of right ankle, fracture of ribs, purulent infiltration of deep tissues of the right leg, slight suppurative nephritis, streptococcus septicæmia.

Kidneys. Capsules strip revealing numerous small cortical cysts. The markings are obscured. The ureters are free. The bladder and prostate are not remarkable.

Microscopic examination. A small papillary adenoma of the kidney is present, also occasional areas of fibroid atrophy with cyst formation. In two or three places are small suppurative areas.

Bacteriological report. Cultures from the heart blood and spleen show streptococcus pyogenes. Cultures from the liver show a few streptococci and many colon bacilli. *Sections stained for bacteria.* A few chains of streptococci are found in the blood-vessels of the kidney and in the areas of suppuration.

CASE 25. Autopsy No. 2854. West Medical 784–186. Female, age 44. February 23, 1911.

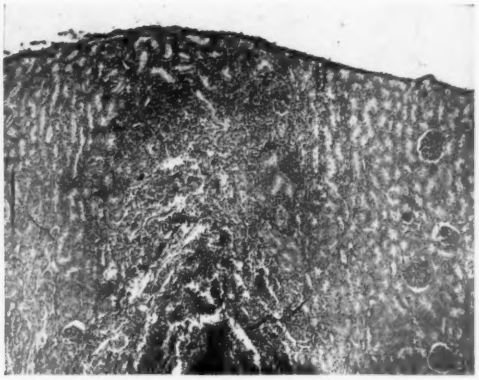


Fig. 9. Upper edge of small cortical abscess 2 millimeters below the capsule. Infecting agent pure staphylococcus albus. Note that tubules above the abscess contain no pus. There is extensive infiltration of the interstitial tissue extending from the abscess to the cortex. Neighboring tissue is normal. Photo by L. S. Brown, x 40.

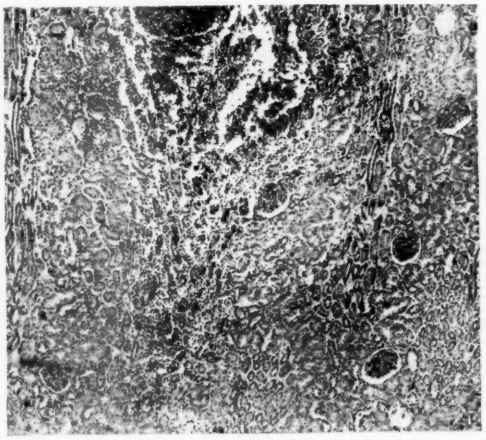


Fig. 10. Lower edge of abscess shown in Fig. 9. Note line of tubules filled with pus extending down into the kidney. There is some pus-cell infiltration of the interstitial tissue. Photo by L. S. Brown, x 40.

Past history. Long standing anæmia. *Present illness.* Still continues weak with a variety of symptoms chiefly of dyspnœa and gastro-intestinal upsets. *Physical examination* shows anæmia and cardiac lesions. *Urine* at entrance negative save for unexplained small trace of albumin. *Temperature* continued as it had been before, a slight evening increase to 99–100°. Was given 0.6 gram "606" intramuscularly in left gluteal region, followed by vomiting and soreness in the buttocks and induration with some increase of temperature. Twenty days later still some induration about site of injection of salvarsan. One month after entrance to hospital urine began to show blood and pus in small amounts. Lungs show signs of œdema. Condition thought to be arsenic poisoning and excision of reservoir of "606" done. Wound discharged freely and sloughed. Patient died at the end of four months. *Clinical diagnosis:* Pernicious anæmia, arsenic poisoning, emaciation.

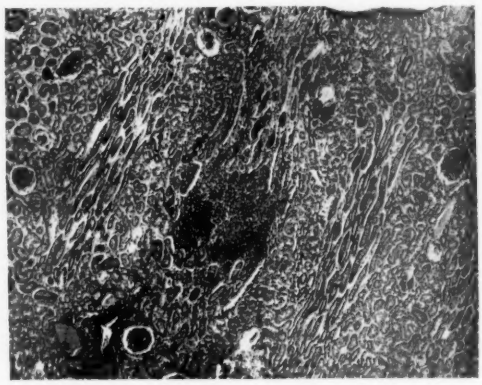


Fig. 11. Small abscess found immediately below abscess shown in Figs. 9 and 10 in a column of Bertini. Note line of tubules filled with pus-cells and found to contain bacteria extending upward to connect with similar tubules shown in Fig. 10. The abscess shown here is situated in the bend of the loops of Henle. Photo by L. S. Brown, x 40.

Fig. 12. A third abscess underlying the two shown in Figs. 9, 10, and 11, situated in the straight tubules of the tip of the papilla. Elsewhere in the tubules of this pyramid tip are to be found small masses of staphylococci, some with attendant beginning abscess formation. Photo by L. S. Brown, x 40.

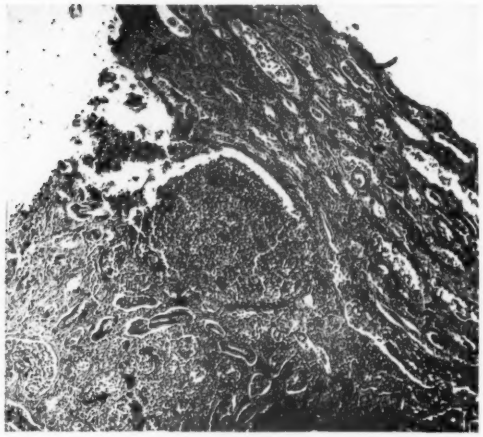


Fig. 13. One of a small cluster of cortical abscesses all of which seem to take origin from glomeruli. Photo by L. S. Brown, x 70.

Autopsy 15 hours post-mortem. Anatomical diagnosis: Arteriosclerosis, nephritis with foci of suppuration, septicæmia streptococcus.

Kidneys. Right kidney weighs 116 grams: capsule adherent. The configuration of the organ is distorted by the presence of two large depressed areas corresponding to areas of extensive atrophy of the renal tissue. About one-quarter of the volume of the kidney is involved in this area. The renal tissue outside of this area shows obscure markings, and the line of demarcation between cortex and pyramids cannot be made out. There is distortion of the pelvis, due to area of atrophy. The left kidney weighs 51 grams. Its capsule is extremely adherent and thickened. Marking of the cortex cannot be made out and the line of demarcation between the cortex and kidneys is not clear. At one point the renal tissue over an area of 1 centimeter is extremely tough and fibrous in character. The pelvis, ureter and bladder are not remarkable.

Fig. 15. Section through glomerulus at the point of entry of the capillary into the glomerulus to form the tuft. Portions of the capsule of Bowman are seen at $a - a$. Note large number of cocci entering the glomerulus in the blood stream. Photo by L. S. Brown, x 1500.

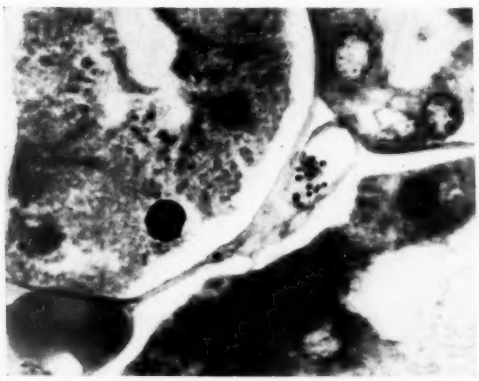


Fig. 14. Microphotograph showing staphylococci in the blood stream of the cortical portion of the kidney. Photo by L. S. Brown, x 1500.

Microscopic examination. Section from the non-atrophic portion of the kidneys shows large tubules and glomeruli. The failure to observe the usual cortical markings at autopsy was probably due to improper incising owing to obscuration of the parts. A second section shows a zone of extreme atrophy extending along beneath the capsule. There is ex-

Fig. 16. Edge of a glomerulus showing staphylococci in the lumen of the capillary and also free in the capsule of Bowman. There is no evidence of rupture of the capillary in this glomerulus. Photo by L. S. Brown, x 1500.

Fig. 17. Microphotograph showing origin first portion of tubule. The glomerulus lies above and to the left. At *a* is to be seen a staphylococcus in diplococcus form entering the first portion of the tubule. The remaining particles are artefacts due to precipitated gram-stain. Photo by L. S. Brown, x 1500.

treme sclerosis of the vessels in this area. At one point there is an area of suppuration in the cortical region. In the left kidney there are several areas of suppuration in the tissue.

Bacteriological report. Cultures from the heart blood show moderate growth of streptococci. *Sections stained for bacteria* show streptococci only. They are located in the tufts of the glomeruli and occasionally in the lymph-spaces. Glomeruli containing streptococci show mild glomerular changes.

CASE 26. Autopsy No. 2344. Neurological 111–119. Male, age 39. February 20, 1909. *Past history.* Two years ago right leg torn and crushed in an accident; an abscess formed which was later opened. *Present illness.* For past six weeks numbness of both feet which gradually extended upward involving the body from the lower half of the abdomen down. Diagnosis of myelitis. *Urine,* at time of entrance, hazy, alkaline, slight trace of albumin and a few pus-cells. *Temperature* normal and remained so during the first thirty days of patient's stay in the hospital at which time he developed bed sores, erysipelas, and septic foot. Died forty-second day. *Clinical diagnosis:* Myelitis, cystitis, erysipelas, bed sores, septic foot.

Fig. 18. A section of the proximal convoluted tubule showing a triad of staphylococci in upper left hand portion of tubule and a clump of cocci at the opposite side. Note the presence of these cocci in the protoplasm of epithelial cells. Photo by L. S. Brown, x 1500.

Autopsy 15½ hours post-mortem. Anatomical diagnosis: Erysipelas, decubitus, hypertrophic bladder and ureters, cystitis, ureteritis, pyonephrosis, early suppurative nephritis, chronic pericarditis, ulcer sole of right foot, combined tract degeneration of the spinal cord, streptococcus septicæmia.

Kidneys. Normal size; the capsules are slightly adherent. The surfaces are smooth and show few small depressions, some of which are pale in color. Markings are retained. Cortex is somewhat narrowed. The pelves and calices are dilated and the papillæ are slightly flattened. Pelvic mucosa is reddened. The ureters are markedly dilated and their walls thickened. The mucosa shows injection. The bladder is thick and red.

Microscopical examination. The sections show areas in which the renal tissue is infiltrated with plasma cells, lymphocytes and leucocytes, and the renal tissue is disintegrated. The leucocytes are generally in the minority which may be regarded as indicating a beginning suppuration.

Bacteriological report. Cultures from the heart blood show a growth of streptococci. *Sections stained for bacteria* show a few streptococci in the blood-vessels and one or two of the glomeruli. The section preserved from the autopsy contained no abscesses.

CASE 27. Autopsy No. 1222. East Medical 607–14. Female, age 25. April 29, 1904. *Present illness.* Three months ago for no apparent reason left leg became swollen and has remained so. Has had considerable abdominal and gastric distress with vomiting. Irregular septic temperature normal to 100° with premortal rise. *Urine,* acid, albumin slight trace, numerous epithelial cells, leucocytes,

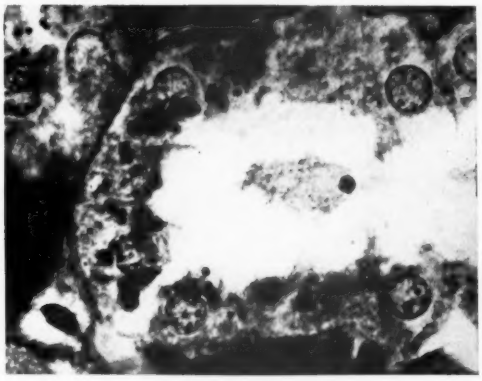


Fig. 19. Portion of distal convoluted tubule showing many staphylococci phagocyted by epithelial cells. A group of cocci free in the lumen of a neighboring tubule are to be seen in the upper left hand corner of the picture. Photo by L. S. Brown.

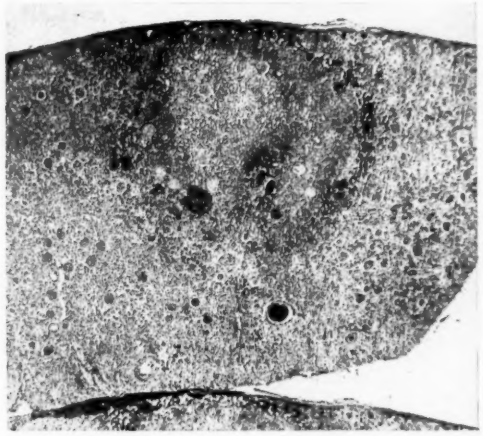


Fig. 20. Small anæmic infarct of cortex showing cross section of artery plugged with a septic embolus. A branch of the artery also thrombosed and containing bacteria is to be seen at the lower edge of the infarcted area. Photo by L. S. Brown x 40.

and red blood-corpuscles. White blood count 6800. Patient later developed suppression of urine. White count increased to 13,600, urine became alkaline in reaction, abdomen extremely tender and distended. Patient suddenly became comatose and died at the end of the thirty-second day. *Clinical diagnosis:* Thrombosis of left thigh.

Autopsy 15¼ hours post-mortem. Anatomical diagnosis: Syphilitic or tuberculous tumors of both groins and retroperitoneal tissue constricting the left ureter, thrombosis in the inferior vena cava, left hydronephrosis with dilatation of ureter, chronic interstitial nephritis, general fibrinopurulent peritonitis, chronic pelvic peritonitis, streptococcus septicæmia. Abscess foci, necrosis, and thrombi in branches of right renal vein and kidney.

Kidneys. Right kidney weighs 145 grams, left 78 grams. Right kidney capsule strips, leaving smooth surface showing in several places slightly depressed reddish yellow to black areas. On section these areas are seen to be the outer surfaces of small streaks and rounded masses (infarcts) which extend a short distance into the kidney tissue. The pelvis is very slightly increased in size and the mucosa shows a few small reddish areas. The ureter is normal save for fibrous thickening of the periureter tissue along its upper half. The left kidney capsule is slightly adherent in places. On section the pelvis is markedly dilated, and at its middle third is lost in a mass of fibrous tissue. The lower third of the ureter is normal in size.

Microscopic examination. Kidneys show rather diffuse increase of interstitial connective tissue, most marked in the left. In the right kidney branches of a renal vein contain thrombi. The kidney shows areas of necrosis and one abscess.

Bacteriological report. Cultures from the heart, blood, and spleen show profuse growth of streptococcus pyogenes. *Sections stained for bacteria* show the pyramidal areas previously described to consist of necrotic pale tissue in their central portions. The blood-vessels contain no blood. Surrounding these areas of necrosis the blood-vessels are congested. There is some infiltration of leucocytes and at the tip of the area toward the pelvis are to be found in one or two instances thrombi in the arteries which contain streptococci. No other bacteria are found. There are no bacteria found in the majority of the infarcted areas. In one, however, in which the process has gone on to suppuration the central portion of the pyramidal area is filled with leucocytes and necrotic renal cells and contains a large number of streptococci, some in long chains.

CASE 28. Autopsy No. 3520. West Medical 1012–1. Male, age, 40. November 18, 1915. *Admission diagnosis.* Cardiac decompensation, bronchopneumonia. No previous urinary symptoms. *Present illness.* Sudden chill and weakness five weeks ago since which time he has shown temperature with symptoms of cardiac decompensation. *Urine* examination not recorded. Patient died third day. *Clinical diagnosis.* Cardiac decompensation, bronchopneumonia.

Autopsy 25½ hours post-mortem. Anatomical diagnosis: Chronic adhesive pericarditis, mediastinitis, pleuritis, hypertrophy and dilatation of the heart, chronic passive congestion, pneumonia of the inferior lobe of right lung, infarcts of left kidney.

Kidneys. Right weighs 140 grams. Capsule strips easily. The markings are retained and the cortex is not narrowed. The pelvis and ureter are negative. Left kidney weighs 170 grams, capsule strips leaving a smooth surface which shows in two places small yellowish areas, which on section, are

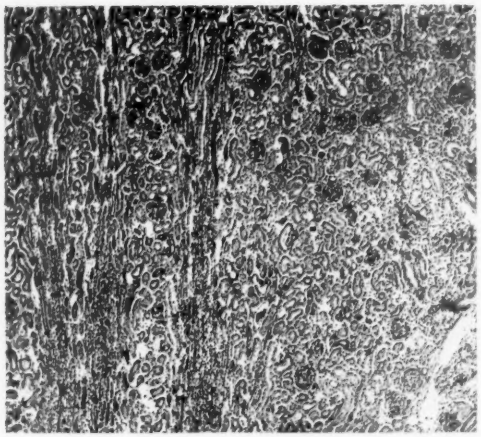


Fig. 21. Typical area from the kidney of a child with chronic pyelonephritis which now presents the picture of a pure pyelitis. The kidney tissue is normal throughout. Photo by L. S. Brown, x 45.

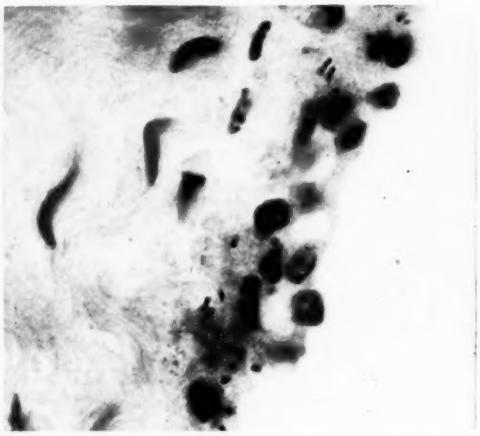


Fig. 22. Microphotograph of portion of pelvis (same case as Fig. 21) showing slight thickening mucosa without submucous change and large numbers of colon bacilli growing in the mucosa. Photo by L. S. Brown, x 1500.

seen to be the basal surface of small pyramidal masses extending into the tissue for a short distance and are marked off from the rest of the kidney substance by narrow pale red margins. The largest infarct measures 5 millimeters at the base. The markings are retained and the cortex is not narrowed. The pelvis and ureter are negative; the bladder and prostate are negative.

Microscopic examination. The kidney shows acute degenerative changes in the epithelium, in each of two sections a small infarcted area.

Bacteriological report. Cultures from the spleen show no growth. *Sections stained for bacteria.* In the cortical region is situated a small pyramidal area with the base at the periphery and the tip extending down into the cortical substance to a point between the bases of the two pyramids. The center of this area shows homogeneous, acutely degenerated kidney substance without cell infiltration. In the region of the capsule the blood-vessels are tremendously engorged with some polymorphonuclear infiltration. This area of engorgement forms a border about one millimeter in thickness over the surface of the infarct. At the tip of the infarcted area two small arteries are found plugged with thrombi containing a few organisms of the pneumococcus streptococcus group (Fig. 20). The periphery of the infarcted area consists of engorged blood-vessels with rupture of some of these vessels and liberation of red cells into the tissue and a moderate infiltration with polynuclear leucocytes. No bacteria are found in any portion of normal kidney tissue or infarcted area except within the two arteries plugged with thrombi already mentioned.

The lesions above described are shown in these cases as follows: perinephritic abscess was demonstrated in Cases 4 and 9, capsular abscess and capsulitis appear in cases 6 and 9, cortical abscesses appear in cases 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, and 27. Septic infarct was demonstrated in Cases 10, 13, 21, 17, and 18, while diffuse suppuration appears in Cases 4, 7, 21, and 26.

THE LESIONS PRODUCED BY THE COLON-TYPHOID GROUP OF BACTERIA

The lesions characteristic of this group of organisms are acute pyelitis, acute pyelonephritis, chronic pyelonephritis, and pyonephrosis. As evidence of this we submit Cases 29 to 33.

CASE 29. Autopsy, No. 3503. Children's Medical, vol. 33, p. 75. Female, age 4 months. September 16, 1915. *Present illness.* For one week before entrance child began to look sick but continued to eat well; for past two days has been feverish. *Physical examination* negative. Since entering the hospital temperature has continued irregular and high, varying from 100 to 103°, with a premortal rise to 107°. Child unable to take food except in one ounce amounts. Continued to lose strength and died thirteenth day. *Urine* at entrance showed small trace of albumin, many pus-cells and at four subsequent examinations findings continued the same. *Examination of stool* negative. *Culture of urine* bacillus coli. *Clinical diagnosis:* Pyelonephritis. Toxic absorption. Heat prostration.

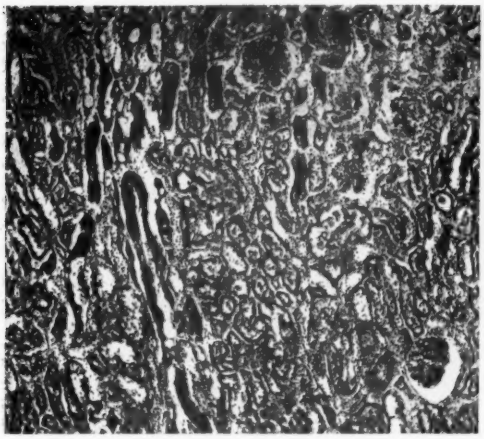


Fig. 23. Typical appearance of the kidney of a chronic colon bacillus pyonephrosis, the result of a pyelitis of infancy. Note moderate lymphocytic infiltration and extensive damage to convoluted tubules. The glomeruli are unchanged. Photo by L. S. Brown, x 45.

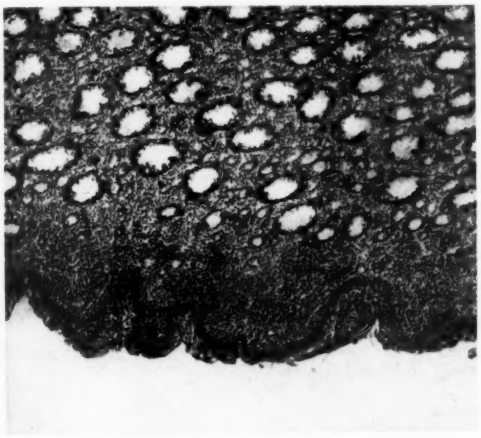


Fig. 24. Pelvis of same case as in Fig. 23 showing thickened mucosa and submucosa, increase in interstitial tissue and dilated collecting tubules of the pyramid. The submucosa is extensively infiltrated with lymphocytes and an occasional pus-cell. Colon bacilli are numerous in the mucosa, rare in the remainder of the kidney. Photo by L. S. Brown, x 45.

Autopsy 22½ hours post-mortem. Anatomical diagnosis: Bronchitis, emaciation, fatty metamorphosis of the liver, slight defective closure foramen ovale.

Kidneys. Combined weight 26 grams. Capsules stripped leaving pale, smooth surface. On section the tissue is of good consistence. Markings are made out and cortex measures 2 millimeters. In the pelvis of one kidney there are three or four minute yellowish fine concretions. Pelves otherwise negative.

Bacteriological report. Culture from the heart at autopsy shows no growth.

Microscopical sections of the kidney show some acute degeneration of the tubules, no glomeruli change (Fig. 21). *Sections stained for bacteria* show slight thickening and polynuclear infiltration of the mucosa of the papilli and calices throughout the section with large numbers of bacilli scattered throughout the mucosa among the cells (Fig. 22). The glomeruli, tubules and interstitial tissue show no bacteria. There are no bacteria in the blood-vessels or lymphatics. In one portion of the section a portion of a pyramid lying in contact with a recess of a calyx shows over an area extending 2 to 3 millimeters into the tissues, a few isolated bacilli unattended by pathological change lying in the lymphatics of the interstitial tissue.

CASE 30. Female, age 15, private patient of Dr. Hugh Cabot, January 15, 1915. *Diagnosis,* left pyonephrosis. *Past history.* Since infancy has had more or less pyuria, the amount of pus in the urine having decreased considerably during the last four years. During the past five or six years has had prolonged course of treatment with autogenous vaccines. The urine has always contained large amounts of pus, albumin, and micro-organisms which have been variously classified as bacillus coli and proteus by different observers.

Cystoscopy shows some diffuse redness of the bladder. Right ureteral orifice normal. Urine from the right ureter clear and clean. The left ureteral

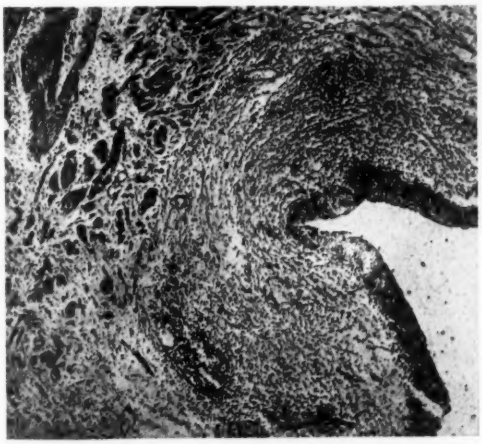


Fig. 25. Section of ureter from case shown in Figs. 23 and 24 showing thickened mucosa and submucosa with two collections of cells in the submucosa. There are few pus-cells in the submucosa. Bacteria along with pus-cells are found in the mucosa. Photo by L. S. Brown.

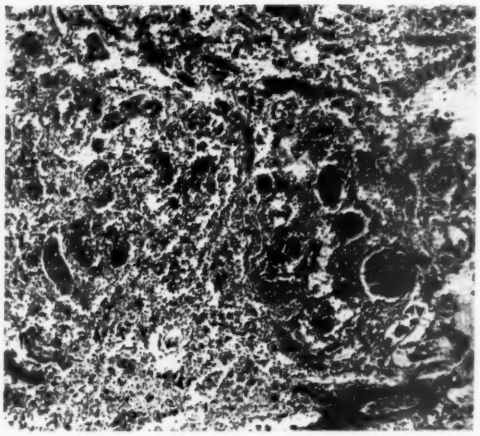


Fig. 26. Typical picture of pyelonephritis due to the colon bacillus in a case in which the conditions requisite for ascending infection were present. Note normal glomeruli, dilated tubules filled with pus and desquamated epithelium and moderate interstitial infiltration with lymphocytes and a few pus-cells. Photo by L. S. Brown, x 45.

orifice is œdematous and the urine from the left ureter is very dilute, slightly turbid, and flows freely. Phenolsulphonephthalein functional test, intramuscular injection; right kidney — appearance time, six minutes, amount in one hour 20 per cent; left, 15 minutes, one hour amount 3½ per cent. The capacity of the left pelvis is 50 cubic centimeters plus. Injected radiograph shows very large dilated pelvis and ureter with widely dilated calices.

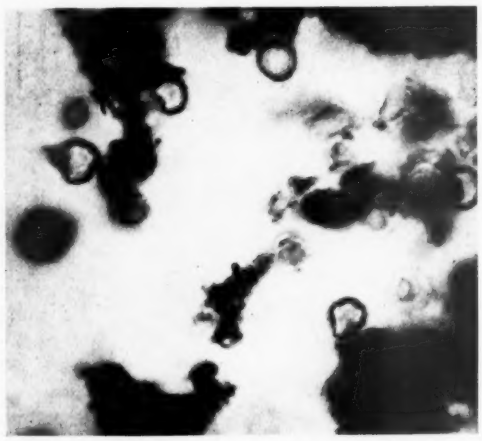


Fig. 28. Same case as shown in Figs. 26 and 27. Colon bacilli in the blood stream of the kidney. Photo by L. S. Brown, x 1500.

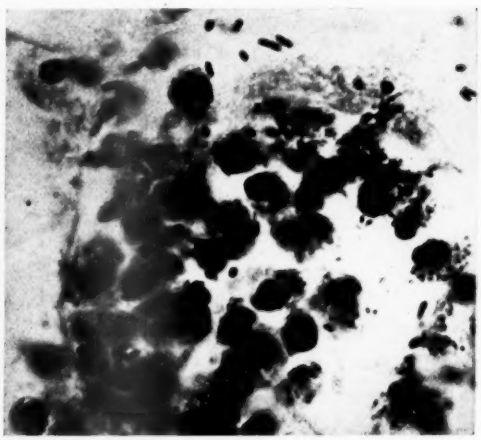


Fig. 27. Microphotograph of one of the dilated tubules filled with pus and desquamated epithelial cells. Note that the tubule is definitely the center of bacterial activity and pus production. A few bacilli are seen breaking through the tubules into neighboring tissue. They are unattended by pathological change. Bacilli treated with formalin. Photo by L. S. Brown, x 1500.

Right urine shows only a few red blood-cells (traumatic); stained sediment shows no bacteria. *Left urine* shows albumin, very slight trace; sediment much pus, many irregular sized motile bacilli, considerable renal epithelium. Stained sediment shows one type of organism present, a gram-negative bacillus. Cultures right urine no growth; left urine shows a profuse growth of a gram-negative bacillus cultural characteristics and agglutination test classifying it as bacillus coli communior. *Operation.* Left nephrectomy with removal of ureter to the brim of the pelvis. Rapid and uneventful convalescence.

Pathological report. The specimen consists of a kidney and fragment of ureter 12 centimeters long. The kidney is slightly enlarged. The circumference of the ureter varies from 3 to 4 centimeters. The split kidney shows extensively dilated calices with very little kidney substance remaining. The kidney cortex measures from 1 to 4 millimeters in thickness. The kidney tissue remaining is rather pale, markings can be made out, and the capsule strips easily save in a few places. The pelvic mucosa is markedly thickened and has a finely granular non-reflecting surface. The ureter shows the same thickening of mucosa as the pelvis. The infiltrative process in many places extends through the muscularis and is marked about the blood-vessels.

Microscopic section shows a somewhat thickened capsule. The glomeruli for the most part are undamaged. In other areas a few show a smooth hyaline appearance. There is some round-cell infiltration of the interstitial tissue generally distributed over the section. A portion of the convo-

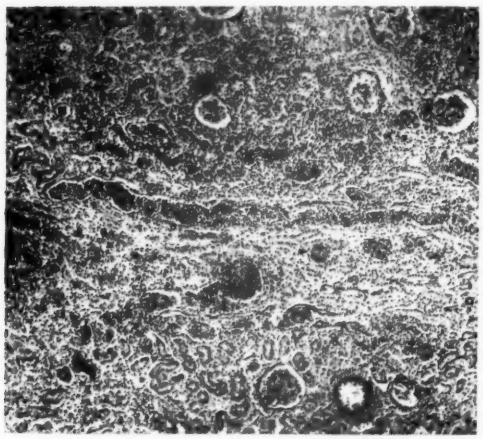


Fig. 29. Microphotograph of another typical pyelonephritis similar to that shown in Figs. 26, 27, and 28, save that in this case there was no previous cystitis, bladder instrumentation, or condition of bladder or ureter damage. An ascending infection was clearly impossible in this case. Photo by L. S. Brown, x 45.

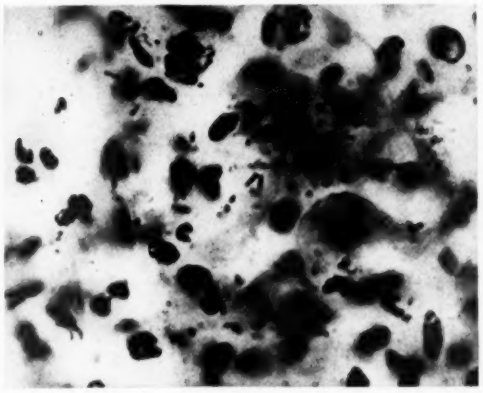


Fig. 30. Destruction of tubule by colon bacilli. Same case as Fig. 29. Photo by L. S. Brown, x 1500.

luted tubules show hyaline degeneration (Fig. 23). In a few of these the epithelium is desquamated and is found in the lumen of the tubules lower down. The lumina of the tubules are generally dilated, particularly in the pyramids, in which area there is also considerable interstitial thickening. The mucosa of the pelvis is much thickened and infiltrated with pus-cells (Fig. 24). Just beneath the pelvic mucosa, is infiltration with round cells and a few polynuclear leucocytes extending into the pyramids for a distance of ½ centimeter. Sections of the ureter wall show some infiltration of the muscularis with some areas of polynuclear cells in the periureteral tissue. The mucous membrane is much thickened and infiltrated with pus-cells. The submucosa shows dense lymphocytic infiltration (Fig. 25) with a few pus-cells.

Sections stained for bacteria show no bacteria throughout the greater portion of the kidney. The area of submucosa infiltration in the pelvis, tips of pyramids, and the ureter show a few scattered bacilli. The pelvic and ureteral mucosa and masses of debris within the pelvis and ureter show large numbers of colon bacilli. The groups of desquamated epithelial and pus-cells previously described in the lumina of the convoluted tubules show no bacilli. In some few areas single bacilli were found in the lymphatics of the interstitial tissue of the pyramids.

CASE 31. Autopsy No. 2035. West Medical, 678–101. Female, age 18. September 21, 1907. *Present illness.* Since childhood has had a complex group of symptoms, but none of a urinary nature, chiefly of gastric disturbance. The diagnosis of hysteria and gastric neuritis has been frequently made at several Boston hospitals. *Temperature* at entrance normal. *Urine* negative. White blood count 6,500. Patient remained in the hospital for 26 days when she developed a temperature, symptoms of bronchopneumonia and died ten days later. *Urine examination* one week before death showed acid reaction, very slight trace of albumin, moderate number of pus-cells without casts. *Clinical diagnosis:* Hysteria, bronchopneumonia.

Autopsy 7½ hours post-mortem. Anatomical diagnosis: Extensive bronchopneumonia, suppurative nephritis, acute degeneration of the myocardium, soft spleen, fatty liver.

Kidneys. Combined weight 245 grams. In one kidney there are numerous large and small dark red blotches in the cortex. On section these blotches correspond to red bands and streaks of varying width extending from the cortex into the pyramids. The pelves are not dilated; the ureters are negative.

Microscopic examination of the kidneys shows suppuration.

Bacteriological report. Cultures from the heart blood show a few colonies of bacilli. *Sections stained for bacteria* show an extensive suppurative nephritis of the pyelonephritic type. Bacilli are found only in the convoluted and collecting tubules and the pelvis. There are no cocci.

CASE 32. Autopsy No. 858. South Surgical, vol. 61, p. 65. Male, age 56. March 21, 1902. *Diagnosis.* Cancer stomach and liver. *Past history*, negative as regards kidney symptoms. For 2 years loss of weight and strength associated with severe gastric symptoms. Physical examination shows tumor mass in epigastrium. Negative kidney examination, and negative urine although no sediment was done. *Operation.* Exploratory laparotomy for adenocarcinoma of stomach and secondary carcinoma of liver with drainage of wound.

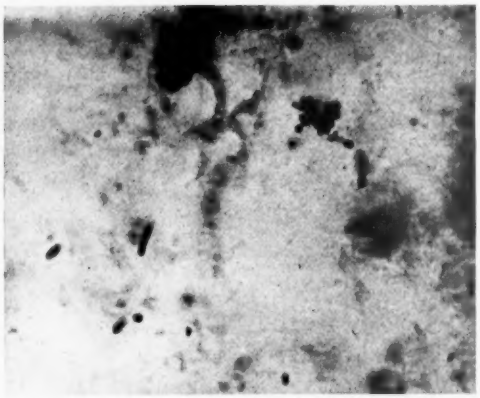


Fig. 31 Mixed colon bacillus and staphylococcus infection in a kidney removed at operation. Cultures taken at operation were reported bacillus coli alone. Pathological examination showed multiple abscess formation. Error in diagnosis of the nature of the infection from dependence upon culture was due to overgrowth of staphylococci by the colon bacillus. Photo by L. S. Brown, x 1500.

Patient had to be catheterized permanently from operation until death. Temperature remained subnormal throughout illness. Patient extremely weak and losing ground constantly. Wound showed a constant discharge of chylous fluid with some suppuration. Patient died quietly on twenty-second day.

Autopsy 15 hours post-mortem. Anatomical diagnosis: Adenocarcinoma pancreas with metastases in the mesentery, lesser and greater omentum, walls of the intestine, stomach, peritoneum, liver, and the left adrenal; ascites; fibrinous peritonitis; chronic adhesive pericarditis; arteriosclerosis of vessels of Willis, suppurative nephritis; slight dilatation of the pelvis of the right kidney; slight chronic interstitial nephritis right kidney. Laparotomy wound; healed fracture left humerus.

Kidneys. Combined weight 260 grams. *Left kidney* capsule strips leaving a smooth surface mottled in places with pinhead sized yellowish areas distinct and in small groups. In one place these areas show red mottling. On section they extend over a short distance into the cortical tubules. The markings are retained. The tissue of the upper portion of the pyramids and cortex shows some red marking and pinhead sized yellow and red areas. Pelvis and ureter not abnormal. *Right kidney* capsule strips leaving a smooth surface. On section the kidney tissue is firm, the markings retained, and the section surface generally is flint colored. There is some slight dilatation of the ureter and pelvis. On section the mucosa of the ureter is not remarkable and entrance of ureter into bladder is free. The portion of the ureter which runs through the bladder-wall is the smallest in caliber. Bladder not remarkable.

Microscopic examination. The sections show abscesses in small cortical tubules (Fig. 26). There is cloudy swelling of many of the convoluted tubules. There is also some arteriosclerosis. In other portions of the kidneys there is increase in the interstitial connective tissue with atrophy of many of the convoluted tubules and fibrous thickening of some of the glomerular capsules.

Bacteriological report. Cultures from heart blood, no growth; cultures from liver, bacilli of the colon group; cultures from the spleen, a few colonies of streptococci. *Sections stained for bacteria.* The picture is typical of a pyelonephritis (Fig. 26). Glomeruli are normal throughout the section save where they are secondarily invaded by suppurative processes within the neighboring tubules and are even then free from bacteria. Everywhere the tubules are dilated and filled with pus and desquaminated epithelial cells. There is considerable lymphocytic and moderate pus-cell infiltration of the interstitial tissue. Bacteria are rarely seen in the interstitial tissues. Large numbers of gram-negative bacilli are found among the pus-cells of the dilated tubules (Fig. 27). As a rule no bacilli are to be found in glomeruli. In a few of the larger veins and arteries an occasional bacillus is seen (Fig. 28). In some of the tubules masses of bacilli are to be found apparently occupying what was once the lumen of a tubule. In some instances in what appears to be an abscess are to be seen the remnants of three or four tubules filled with bacilli serving as the centers of infection for the confluent mass which has resulted in small abscess formation. There are no cocci.

CASE 33. Autopsy No. 510. South Surgical, vol. 34, pp. 94, 252, 249. Female, age 56. November 5, 1899. *Diagnosis,* fibroma uterus. *Past history,* entirely negative as regards kidney symptoms. Entire complaint is vaginal discharge and hæmorrhage. *Physical examination* negative save for the presence of a large fibroid uterus. *Operation.* Complete hysterectomy with drainage. Patient in extremely poor condition from shock at the end of operation. After operation patient continued to run a swinging temperature varying from 100 to 102.8°. Developed tenderness in both costovertebral angles. Gradually failed and died on fourteenth day. *Urine specimen* reported on day of death was said to have shown no albumin; sediment was not done. *Autopsy* 29½ hours post-mortem. Anatomical diagnosis: Hysterectomy, circumscribed peritonitis, with purulent infiltration and necrosis of tissues of the abdominal wall near wound, multiple old infarcts of spleen, chronic mitral endocarditis, cholelithiasis, suppurative nephritis.

Kidneys. Capsules strip easily and leave a granular surface thickly dotted over with gray opaque mottling. On section cortex is increased in width 8 to 9 millimeters. Cortices present a mottled gray opaque appearance from the presence of numerous discreet and confluent pinhead sized opaque areas. Pyramids show gray lines. The

mucosa of the pelvis shows reddening and ecchymotic areas. Bladder reddened.

Bacteriological report. Cultures from heart, liver, spleen, and kidneys show colonies of a bacillus which was not classified but seemed from its growth on agar to belong to the colon group.

Microscopic examination of the kidney shows some post-mortem degeneration, extensive infiltration of polynuclear leucocytes with disappearance of the renal epithelium over considerable areas of tissue so that abscesses are formed; some dilated tubules filled with polynuclear leucocytes and epithelial cells (Fig. 29).

Sections stained for bacteria. The picture is typical of a pyelonephritis (Fig. 29). Glomeruli are as a rule free from bacteria and also free from pus save where invaded from neighboring tubule processes. The interstitial tissue shows considerable lymphocyte and some pus-cell infiltration. Throughout the section the tubules are dilated and filled with clumps of bacteria, pus, and desquaminated epithelium. Few bacteria are found outside the tubules. Where bacteria are found outside the lumina of tubules, the renal epithelium is usually extensively destroyed with evidences of liberation of the contained bacteria (Fig. 30). Where definite abscess formation appears, close observation shows the centers of suppuration to be remnants of tubules which have been extensively destroyed. The appearance of true abscess is due to confluence of the destructive processes in several neighboring tubules. There are no cocci seen in the section. Large numbers of gram-negative bacilli, mostly in tubules, are clearly the etiological factor in the process.

NOTE.—The striking similarity between the findings in this case and the preceding, Case 32, is of interest because in the former the conditions for an ascending infection exist, while in this case by no stretch of the imagination can the bladder be considered the origin of the renal condition. One might be an ascending infection, the other clearly cannot be, yet the pathological pictures presented are indistinguishable.

In this group of cases acute pyelitis and also chronic pyelitis are shown in Cases 29, 30, 31, 32, and 33. Acute pyelonephritis does not appear and its incidence is inferential as we shall later show. Chronic pyelonephritis is shown in Case 30, as is pyonephrosis.

INFECTION OF THE KIDNEY WITH BOTH NON-PYOGENIC AND PYOGENIC ORGANISMS WILL PRODUCE A MIXTURE OF THE LESIONS CHARACTERISTIC OF BOTH GROUPS

This fact we believe explains the not uncommon fallacy that the colon bacillus will produce abscess of the kidney. This has been freely stated and appears to have been supported by the evidence of cultures obtained from the kidney. This reasoning we have shown to be fallacious for two reasons: First, cultures containing both colon bacilli and cocci will frequently be interpreted as showing only colon bacilli since this organism grows with great rapidity and readily obscures the colonies of cocci. Second, it has been assumed that the cultures obtained from one part of a kidney represented the lesions produced in the whole kidney. This we have shown to be fallacious by the actual demonstration of bacilli in one portion of the kidney, cocci in another, and cocci and bacilli associated together in still other portions (Fig. 31). Our experience has led us to believe that in these mixed infections, the colon bacillus probably precedes the coccus in point of time. Only in this way can be explained the appearances in certain kidneys which will be below described. These mixed lesions are rather likely to be found in cases occurring in Group II of our classification,

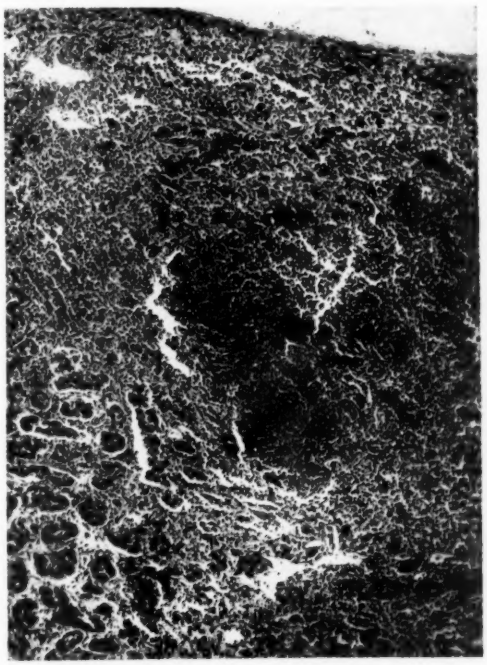


Fig. 32. Microphotograph of true abscess due to bacilli. One of the organisms is the colon bacillus, the other a gram-positive organism. Photo by L. S. Brown, x 70.

that is to say, kidneys handicapped by previous disease. In support of these propositions we submit Cases 34 to 56 showing mixed infection with cocci and bacilli, Cases 67 and 68 showing infection with two different kinds of cocci, and Cases 59 and 60 showing infection with two different kinds of bacilli.

CASE 34. Autopsy No. 841. West Medical, 564–88. Female, age 51. March 1, 1902. *Present illness.* Six days ago became dizzy (uræmia?), fell, and had a severe convulsion followed by mental aberrations. *Urine*, acid, 1007, albumin ½ per cent, very small amount of pus and casts. *Temperature* averaged about 100°. *White blood count* 28,000, which later rose to 45,000. Patient gradually lost strength, became more irrational, becoming comatose. Temperature became subnormal and death occurred sixth day. *Clinical diagnosis:* Chronic nephritis.

Autopsy. 18 hours post-mortem. Anatomical diagnosis: Chronic interstitial nephritis, suppurative nephritis, congenital malformation of the kidneys and anomaly of the right ureter, bronchiectasis with concretion, œdema of the lungs, hydrosalpinx.

Kidneys. Small and of unequal size; weight of left kidney 13 grams, right kidney weighs 51 grams, left kidney shows fœtal lobulations and deformity. Capsule adherent. The markings are scarcely recognizable. In two areas are small cysts. Abnormal arrangement of the renal arteries. Right kidney is also deformed, its pelvis being nearer one pole than usual. Capsule adherent. The distinction between cortex and pyramids is obscured. The markings of the cortex are absent. At one point in the renal tissue is a cavity 6 millimeters in diameter full of pus. Ureter is of normal caliber until near the bladder when it becomes dilated. Its orifice in the bladder not found but in the situation of its orifice is a swollen area which on section exudes thin purulent fluid. A fibrous cord connects the pelvis with the lower portion of the ureter to which it is joined a few millimeters from the bladder. It has no lumen. *Bacteriological report.* Liver and spleen show bacillus coli communis. *Sections stained for bacteria* show many staphylococci in plugs in a few of the tubules, a considerable number of gram-negative bacilli are found in the pelvis of the kidney. There are no abscesses in the sections preserved.

CASE 35. Autopsy No. 1076. West Surgical, 403–163. Male, age 40. June 24, 1902. Patient brought to Accident Room unconscious with fracture of cervical vertebra. *Urine* examination on admission negative. Six months later slight trace of albumin, hyaline casts, much pus. Patient has been catheterized since injury. *Irregular temperature* with occasional chills for past four months. Death from exhaustion and sepsis on three hundred twentieth day. *Clinical diagnosis:* Cervical fracture.

Autopsy 6½ hours post-mortem. Anatomical diagnosis: Calculus pyelitis and ureteritis with suppurative nephritis of the right kidney; obstructing stone in ureter, cystitis, infarct right lung, scar of old fracture of cervical vertebra.

Kidneys. Combined weight 440 grams. Capsules strip easily leaving a smooth surface showing some red mottling. Left kidney shows fairly firm tissue without narrowing of the cortex. In places the section surface is mottled with red areas. The right kidney tissue is somewhat soft, section surface generally pale with retained markings. The cortex is slightly narrow. In many places and especially in the cortex are numerous small red areas. The pelvis of the right kidney is dilated; its mucosa is grayish red and bathed in dirty yellowish purulent material. The calices are dilated and contain small yellowish concretions. The upper portion of the ureter for a distance of 2 centimeters is dilated, its mucosa roughened and grayish to red in color. Its lumen is occluded by a small stone. Below this situation the ureter is normal in size. Its mucosa is smooth, showing here and there a few small ecchymoses. The left ureter is normal. Bladder shows dirty, yellowish, foul fluid, and its mucosa presents numerous red patches.

Microscopic examination. Right kidney shows extensive infiltration with round cells, in places also infiltration with leucocytes. The left kidney shows renal tissue to be infiltrated, in areas, with pus-cells, and the normal kidney structure is disintegrated at these points.

Bacteriological report. Cultures from the heart, liver, and spleen show liquefying scum of growth of bacteria. *Sections stained for bacteria.* A considerable variety of bacteria some of which are staphylococci are found scattered throughout purulent areas in the kidney. Many bacilli.

CASE 36. Specimen number 92–61. South Surgical, 176–211. Male, age 53. February 19, 1909. *Present illness.* For two months has had carbuncle on the back of the neck. For one month has had nausea, some vomiting and intestinal disturbance, chiefly diarrhœa.

Operation, appendectomy. Chronic appendix found and removed. Following operation a patch of dullness located in left lower back. *Cystoscopy* showed small amount of pus from the right ureter; *X-ray* negative. Culture from the bladder urine showed colon bacilli with a few colonies of staphylococci. Cultures from the appendix wound which had become septic showed staphylococcus aureus and colon bacilli. Diagnosis of acute hæmatogenous kidney made and operation determined upon. Small perinephritic abscess found, cultures from which showed staphylococcus aureus. The kidney was found generously sprinkled with small abscesses. Nephrectomy done.

Pathological report. Kidney considerably enlarged, weight 200 grams. Capsules thickened. There is a large abscess at one pole of the kidney, and numerous small abscesses scattered throughout

the remainder of the kidney cortex. These are filled with thick tenacious pus showing small micrococci in clumps.

Microscopic examination showed multiple abscesses. Diffuse round-cell infiltration of remaining tissue with obliteration of tubules and glomeruli.

Pathological diagnosis: Focal suppurative nephritis.

Sections stained for bacteria. A large number of staphylococci and a moderate number of gram-negative bacilli are found in the small abscess cavities and some of the tubules and occasionally in the lymph-spaces of the interstitial tissue.

CASE 37. Autopsy No. 859. South Surgical, LX-258. Male, age 56. March 6, 1902. *Past history.* Gonorrhœa 36 years ago; stricture developed six years later. Has frequently had retention. *Present illness.* Inability to pass water. *Urine,* small trace of albumin, large amount of pus.

Operation. Internal and external urethrotomy for multiple stricture. Patient had uneventful convalescence for 19 days at which time he had a sudden rise of temperature to 103°, nervousness, and some vomiting. A few days later patient developed diarrhœa. He died on the thirty-third day. *Clinical diagnosis:* Multiple stricture of urethra.

Autopsy 19 hours post-mortem. Anatomical diagnosis: Chronic cystitis with extension through the bladder-wall and through the perivesical tissue; dilatation of the ureters, double hydronephrosis, ureteritis, pyelitis, suppurative nephritis, suppurative focal pneumonia, atheromatous endocarditis of the aortic valve, healed perineal wound for stricture of urethra, stricture of urethra at the penoscrotal angle.

Kidneys. In each renal pelvis opaque purulent fluid. Kidneys are unequal in size; weight not given. Capsules slightly adherent. At various points on the free surfaces are yellow slightly elevated areas which on section contain milky white pus. The kidney tissue covering the more dilated portion of the pelvis shows atrophy and the markings are obscured. The cortex is diminished in width.

Microscopic examination. Kidneys show increase in the interstitial connective tissue, atrophy of the tubules, infiltration with small round cells; some fibroid atrophy of the glomeruli. Some of the tubules show many pus-cells.

Bacteriological report. Fluid expressed from the kidney shows a number of bacteria many of them gram-negative bacilli, staphylococci, and streptococci. Cultures from the heart, no growth; liver and spleen, bacillus coli communis; kidney, many varieties of bacteria.

Sections stained for bacteria show staphylococci in the tubules, colon-like bacilli in the blood stream and staphylococci and bacilli in the pelvis.

CASE 38. Autopsy, No. 1817. West Surgical, 545-107. Male, age 79. October 1, 1906. *Past history.* For past 15 years has led catheter life on account of enlarged prostate. *Present illness.* Four days ago broke his catheter leaving four inches in his bladder. Temperature normal on admission. *Urine,* alkaline, slight trace of albumin; sediment pus and blood-cells. *Operation.* Perineal section for foreign body followed by partial suprapubic prostatectomy. Patient died as immediate result of this second operation on forty-sixth day after admission. *Clinical diagnosis:* Enlarged prostate and senility.

Autopsy 6 hours post-mortem. Anatomical diagnosis: Diphtheritic, cystitis, ureteritis, and pyelitis, suppurative nephritis right, operation wound, prostatectomy, arteriosclerosis, fibrocalcareous endocarditis, focal tuberculosis of liver.

Kidneys. Combined weight 240 grams. Capsule of left kidney strips leaving a firm, smooth surface. Capsule of right kidney strips leaving a firm, smooth surface showing here and there small abscesses. The pyramids in places show fine grayish yellow streaks. The mucosa of the pelvis is covered with a grayish yellow necrotic membrane. This material extends along the mucosa of the ureter over its entire length. The ureter is moderately dilated. The mucosa of the bladder is covered with exudate and contains foul urine. The walls of the bladder are thickened and in several places there are small diverticula. In the situation of the prostate there is a grayish ragged necrotic cavity.

Bacteriological report. Cultures from the heart blood yield no growth; from the spleen profuse growth of bacilli. *Sections stained for bacteria.* No blocks of kidney tissue were preserved. Sections from the prostate and liver show many staphylococci and a few bacilli. The prostate shows some glandular elements filled with pus in which the bacteria are located. The bacteria in the liver are found in the central veins.

CASE 39. Autopsy No. 2220. West Surgical, 609-53. Female, age 40, September 22, 1908. *Present illness.* For one year definite symptoms of gall-stones. *Temperature,* normal. *Urine* negative. *Operation* cholecochostomy, cholecystectomy. Moderate sepsis of wound, moderate temperature. Seventh day after operation patient became drowsy, urine considerably decreased in amount, bloody, small trace of albumin, some pus, considerable number of cellular casts. Patient died eighteenth day.

Clinical diagnosis: Cholelithiasis, pyonephrosis.

Autopsy 6⅓ hours post-mortem. Anatomical diagnosis: cystitis, ureteritis, pyelitis, suppurative nephritis, arteriosclerosis, slight fibrous endocarditis of the aortic and mitral valves, ulceration of the intestines, chronic peritonitis, operation wound, cholecystectomy, and choledochostomy.

Kidneys. Combined weight 310 grams; capsules strip. Surfaces are mottled with many small, discreet, and confluent yellowish areas which bulge in some places. Section surfaces are mottled with dirty yellowish areas which extend well down into the pyramids. The mucosa of the pelvis shows many minute ecchymoses and small areas of fibrin. The ureters are free and contain pus. The mucosa of the ureters shows ecchymoses; bladder the same.

Microscopic examination. Kidneys show many abscesses and extensive leucocytic infiltration.

Bacteriological report. Cultures from the heart blood and spleen show no growth, from the kidney bacilli.

Sections stained for bacteria show mixed staphylococcus, gram-negative bacillus abscesses of cortex.

CASE 40. Autopsy No. 2221. West Medical, 710–33. Male, age 25. October 6, 1908. *Present illness.* Three weeks of pain in the right kidney region with fever, and for four days severe vomiting. *Temperature* 102 to 105°. *Urine* acid, slightest possible trace albumin, rare cast with pus-cells adherent, considerable pus. White blood count, 25,600. Guinea pig inoculated promptly died. Death too early for evidence of tuberculosis. Patient died fourth day. *Clinical diagnosis:* Hæmatogenous kidney.

Autopsy 13¼ hours post-mortem. Anatomical diagnosis: Septic infarcts and multiple abscesses of right kidney, thrombosis right renal vein, acute localized peritonitis of the right side of the abdomen, septic infarcts and multiple abscesses of lungs, soft spleen, staphylococcus pyogenes aureus septicæmia.

Kidneys. Left kidney weighs 171 grams, tissue is somewhat soft, kidney not otherwise remarkable. The right kidney is enlarged. The cortex is mottled with minute yellow areas from some of which pus oozes when the capsule is removed. On section the markings are lost. Here and there are dark red areas in some of which the central portions show abscesses. The mucosa of the pelvis shows ecchymosis. Both ureters are free. The right renal vein is occluded by a large thrombus.

Microscopic examination of the kidney is not recorded.

Bacteriological report. Cultures from the heart blood, spleen and right kidney show profuse growth of staphylococcus pyogenes aureus and a slight growth of bacilli.

Sections stained for bacteria show staphylococci in the abscesses apparently in pure growth, staphylococci and bacilli in the pelvis.

CASE 41. Autopsy No. 832. West Surgical, 389–238. Male, age 40, November 6, 1902. *Past history.* Gonorrhœa 7 years ago. Now has evidence of stricture. *Present illness.* Acute retention. This morning unsuccessful attempt made by his own doctor at catherization. *Temperature* normal. *Urine,* albumin, trace; sediment, much pus and blood. *Operation.* Dilatation of stricture. Three days later chill, fever, vomiting, followed by suppression of urine.

Operation. Right nephrotomy for pyonephrosis. Kidney found to be dilated, apparently recent infection. Operation did not improve patient's condition and he died fifteenth day. *Clinical diagnosis.* Stricture of urethra, pyonephrosis.

Autopsy 19¼ hours post-mortem. Anatomical diagnosis: Malformation of kidneys with extensive suppurative nephritis; fatty metamorphosis liver, hyperplasia spleen, hypertrophy and dilatation of heart, inguinal operation wound.

Kidneys. In the region of the operation wound is an irregular mass of tissue which extends into the abdomen. This is found to consist of kidney tissue and measures about 14 centimeters in length. Capsule strips leaving a fairly smooth, yellowish brown surface showing in several places yellowish brown areas which on section contain pus. *Cover glass preparations* from this material show numerous leucocytes and a few bacilli. Two ureters are present. The left ureter leads to the pelvic mass of kidney tissue above described, the right opens into the shell of tissue in the right inguinal region.

Microscopic examination. In three sections of the kidney there is considerable post-mortem change and much suppurative nephritis.

Sections stained for bacteria show in the centers of the suppurative areas many staphylococci. A section of the liver shows numerous gram-negative bacilli and staphylococci in the central vein. There are many gram-negative bacilli in the tubules and some suppurative areas surrounding dilated tubules filled with bacilli and cocci.

CASE 42. Autopsy No. 827. East Medical, 561–138. Male, age 53. December 27, 1901. *Present illness.* Symptoms of cerebral embolism of sudden onset. Was put on constant drainage on account of incontinence. Developed urethritis. *Urine examination,* at entrance and all through stay in hospital showed albumin and moderate quantities of pus. Fourteenth day in hospital developed carbuncle. Developed lung symptoms. Culture from carbuncle showed growth of staphylococcus aureus. Died forty-seventh day. *Clinical diagnosis:* Cerebral embolism.

Autopsy 34¾ hours post-mortem. Anatomical diagnosis, chronic cystitis, pyelitis, slight dilatation renal pelves and ureters, suppurative nephritis, arteriosclerosis vessels of Willis, degeneration of posterior columns and crossed pyramidal tracts of the spinal cord.

Kidneys. Capsules strip, surfaces present here and there many brownish yellow spots and indurations. On section through these indurations yellowish muco-pus is obtained. On section kidney shows scattered brownish yellow spots and faint streaks. The pelves of the kidneys show some dilatation with numerous areas of ecchymosis in the walls. Ureters are moderately dilated and filled with thin fluid pus. Ureteral openings are free. Bladder shows areas of ecchymosis and contains a moderate amount of thin pus. Two small abscesses of the prostate.

Cultures of the heart and liver show growth of bacillus coli communis.

Microscopic examination. Foci of suppuration and small abscesses are present. In these are many mononuclear and polynuclear leucocytes. There is a considerable increase in interstitial connective tissue but without lesions of the glomeruli characteristic of chronic glomerular nephritis.

Sections stained for bacteria. Predominant organism scattered throughout the tissue where there is evidence of suppuration is colon-like bacillus, in some areas cocci are to be seen, and in still others, particularly the cortical abscesses, the majority of bacteria are staphylococci.

CASE 43. Autopsy No. 522. South Surgical, 40–80. Male, age 63. September 23, 1899. *Present illness.* For three months has had bladder irritability, nausea, vomiting, and hæmaturia; has been catheterizing himself since onset of symptoms. Patient entered hospital with symptoms of uræmia. *Urine*, acid, albumin ⅛ per cent, sediment, pus, and blood. Died day of entrance. *Clinical diagnosis:* Enlarged prostate.

Autopsy 13 hours post-mortem. Anatomical diagnosis: Adenocarcinoma of the bladder involving both ureteral orifices, cystitis, double hydronephrosis with dilatation left ureter, acute pyelitis right kidney, abscesses of both kidneys, chronic interstitial nephritis, hypertrophy of heart.

Kidneys. Capsules strip easily. Here and there in both kidneys are small pinhead sized abscesses.

Microscopic examination. Sections of the kidneys show marked increase of interstitial tissue with some infiltration with round cells. Tubules of the cortex are greatly diminished in number. Some of those that are present are atrophied and contain hyaline casts. In one section there is moderate infiltration with polymorphoneuclear leucocytes. *Cultures* from the heart and spleen, no growth. Cultures from the kidney, bacillus coli communis.

Sections stained for bacteria. Small abscesses previously described show many staphylococci. A few staphylococci are also found in tubules. Many gram-negative bacilli are found in the pelvis of the kidney in one section. Gram-negative bacilli and cocci are found in the other two sections, one of which contains an abscess.

CASE 44. Autopsy No. 304. East Surgical, 340–83. Female, age 58. August 1, 1898. *Present illness.* For six weeks loss of appetite and vomiting, frequent micturition. For one week pain in the angle of the right jaw. Examination shows alveolar abscess; *white blood count* 8,880. *Urine* acid, albumin slight trace, sugar; sediment, considerable pus. Transferred to Surgical Service. *Operation* alveolar abscess drained. Death of the patient from general septicæmia. *Clinical diagnosis:* General septicæmia, alveolar abscess, diabetes.

Autopsy 14 hours post-mortem. Anatomical diagnosis: Abscess of kidneys, bronchopneumonia with abscess of the lung, arteriosclerosis, wound of neck, general infection, staphylococcus pyogenes aureus.

Kidneys. Enlarged; total weight 462 grams. Capsules adherent. On section several dark red areas are seen scattered through the kidney tissue some extending from the cortex well into the pyramids. These areas show softening and many of them have yellowish white areas within them which yield pus. Markings retained. In one area there is a firm yellowish pyramidal area, fibrous in character, situated between the cortex and the pyramid. Pelvic mucosa slightly injected; bladder shows nothing remarkable.

Bacteriological report. Abscess of neck, heart, spleen, liver and kidneys show profuse growth of staphylococcus pyogenes aureus. *Cover glass preparation* of pus from kidney abscess shows staphylococci, and numerous large irregularly stained bacilli.

Microscopic examination. Kidney abscesses show staphylococci, in many cases phagocyted.

Sections stained for bacteria. Many abscesses are found situated in the cortex. Small abscesses originating in the tubules, sometimes in the convoluted portion, at other times in the ascending and descending loops, are to be found. These small secondary abscesses uniformly underlie the apparently primary larger abscess near the cortex. The abscesses frequently show large clumps of bacteria, which may be seen macroscopically, lying within the necrotic area. In most instances cocci alone are to be found, in others bacilli alone, while in still others the process is mixed. Bacilli and cocci are occasionally found in clumps arrested low down in the collecting tubules. There are both bacilli and cocci in the pelvis of the kidney.

CASE 45. Autopsy No. 301. East Surgical, 338–166. Male, age 65. July 11, 1898. *Past history.* Frequent micturition with slowing of stream for six years. Operation for stricture one year ago. *Present illness.* Recurrence of same symptoms. *Physical examination* shows filiform stricture of bulb. *Operation.* Divulsion of stricture. *Urine* at entrance alkaline, albumin 1/10 per cent, much pus, few red blood-cells. Sixteen days after operation developed temperature and pain in the right kidney region. Temperature increased, suppression of urine, distention; patient died seventeenth day. *Clinical diagnosis:* Stricture urethra.

Autopsy 18 hours post-mortem. Anatomical diagnosis: Suppurative nephritis, pyelitis, ureteritis, slight dilatation of renal pelvis and ureter on right side, hypertrophic bladder with diverticula and cystitis, arteriosclerosis, cardiac hypertrophy, œdema and congestion of lungs, hæmorrhagic infarction of kidney.

Kidneys. Capsules strip leaving smooth surface. On section, tissue mottled red and yellow. In one pole of the left kidney chestnut sized red cyst. Scattered throughout tissue many pea-sized abscesses. Some of these abscesses continue as dark red areas down into the pyramids. The papillary portion of the pyramids shows yellowish white streaks. *Cultures* from kidneys show staphylococcus aureus and colon bacilli. *Sections stained for bacteria.* No abscesses in sections preserved. Gram-negative bacilli clumps of staphylococci and some bacilli are found in the convoluted tubules.

CASE 46. Autopsy No. 1164. South Surgical, 87–55. Male, age 63. November 5, 1903.

Present illness. Eight years ago abscess of perineum, now has filiform stricture. *Urine*, at entrance acid, trace of albumin; sediment clumps of pus, occasional red blood-cell. Patient ran an irregular temperature and died, after operation, on the seventy-third day. *Clinical diagnosis:* Stricture of urethra, cystitis.

Autopsy. Anatomical diagnosis: Pyonephrosis, cystitis, chronic urethritis, perineal fistula, dilatation of ureters and ureteritis, abscess of left kidney, chronic interstitial nephritis, abscess of left epididimis and testicle, streptococcus septicæmia.

Kidneys. Somewhat smaller than normal; capsule adherent. Pelvis, calices and ureters on the right are markedly dilated and filled with a thick, yellow pus. The course of the right ureter is tortuous and at its lower extremity at the bladder wall forms somewhat of a cul-de-sac. The right pelvis is blackish in color and granular. The walls of the pelvis and ureter are thickened. The pyramids of the right kidney are flattened and the cortex narrowed. The markings are obscured. The left renal pelvis, calices and ureter are also dilated. They do not yield pus. At two or three places there are cavities in the substance of the kidney filled with pus. The walls of the kidney, pelvis, and ureter are thickened. The bladder mucosa is dirty blackish in color and rough.

Microscopic examination. A section from one kidney shows fibroid strophy of portions of the renal tissue and an abscess.

Bacteriological report. Cultures from the heart blood show a few streptococci. *Sections stained for bacteria* show staphylococci and gram-negative bacilli scattered throughout the kidney sections. It is impossible to differentiate the extent of post-mortem invasion.

CASE 47. *Surgical Case* No. 9134. South Surgical, 172–5. Female, age 43. November 21, 1908. *Past history* negative save for symptoms attributed to the appendix. *Present illness.* For one week patient has had abdominal pain localizing in the right loin with chills and fever. *Temperature* at entrance 102°; white blood count 15,400. *Urine*, acid, small trace of albumin, considerable pus.

Rectal examination shows tenderness high up in the rectum with œdema and fluctuating mass. *Operation* incision and drainage of ischiorectal abscess. *Second operation* appendectomy, and nephrotomy with drainage for hæmatogenous kidney. Specimen excised for examination.

Pathological report. Two small pieces removed from surface of the kidney; red, hæmorrhagic, with red cells and some leucocytes. *Section stained for bacteria* shows staphylococcus and a large gram-positive bacillus in abscesses.

CASE 48. Autopsy No. 2685. South Surgical, 206–85. Male, age 64. September 3, 1910. *Past history.* Frequent catheterization for past ten years on account of "bladder inflammation." *Present illness.* Complaint frequency. *Urine*, acid, trace of albumin, leucocytes and many bacteria. *Operation.* Exploratory laparotomy for tumor of the bladder. Bladder palpated but not opened. Operation wound remained clean. After operation patient failed without apparent cause and died thirteenth day. *Clinical diagnosis.* Multiple diverticula, enlarged prostate, cardiac insufficiency.

Autopsy 18 hours post-mortem. Anatomical diagnosis: Suppurative nephritis, acute pyelitis, arteriosclerotic, degeneration of kidneys, hypertrophy of prostate, hypertrophy of bladder-wall with diverticula, operation wound.

Kidneys. Combined weight 210 grams. Capsules strip leaving granular surfaces; the tissue is quite firm. The cortex measures 3 to 6 millimeters. Here and there the section surfaces are streaked and mottled with small yellow areas. The pelves and calices are moderately dilated. The mucosa is generally reddened. The walls of the bladder are thickened. A few diverticula and one large one are present. The prostate is considerably enlarged.

Microscopic examination. There is extensive infiltration with polynuclear leucocytes, in one or two places abscess formation.

Bacteriological report. Cultures from the heart blood show no growth.

Sections stained for bacteria. Sections from the kidney tissue which were preserved show but little suppurative process. Staphylococci and bacilli are found, few in number, in the pelvis.

CASE 49. Autopsy No. 321. South Surgical, 28–124. Male, age 66. August 12, 1893. *Present illness.* Prostatic symptoms seven years. Catheterized one month ago and apparently infected at that time. *Operation.* Prostatectomy. *Urine*, smoky, acid, large amount of pus, some blood, large trace of albumin. Died twenty-eighth day. *Clinical diagnosis:* Hypertrophy of prostate, pneumonia.

Autopsy 12 hours post-mortem. Anatomical diagnosis: Suprapubic cystotomy and partial prostatectomy, abscess of region of Scarpa's triangle with sinus formation, thrombosis right femoral vein, abscess of lungs, acute pyelitis with abscesses of kidney, ulcerative prostatitis.

Kidneys. In both renal pelves marked induration of mucosa with some patches of exudate. Cortex 5 millimeters. Tissue slightly pale and in some of the pyramids greyish yellow streaks in the papilla. In one kidney there are two or three pinhead sized abscesses. Sections of the small abscess of the kidney show micrococci with cloudy swelling of the epithelium of the cortical tubules.

Section stained for bacteria show staphylococci in abscesses, bacilli in the yellowish streaks in the papilla, lying within the tubules, bacilli and cocci in the pelves.

CASE 50. Autopsy, No. 2939. West Medical 802–215. Female, age 47. October 6, 1911. *Present illness.* Two years of abdominal symptoms, one week of diarrhœa followed by distention of the abdomen and abdominal pain with much vomiting.

Temperature at admission normal. Later a somewhat irregular fever reaching 100°. *Urine* at admission, no albumin, rare leucocytes. White blood count 8500. *Clinical diagnosis.* Cancer of the stomach, disseminated abdominal cancer.

Autopsy 28½ hours post-mortem. Anatomical diagnosis: Diffuse carcinoma of the stomach with extensive metastasis including the right kidney, carcinomatous strictures of the large intestine, left bronchopneumonia, chronic endocarditis of the mitral valve with stenosis, suppurative nephritis, hydronephrosis right due to constriction of the ureter by neoplasm, small infarct of lung.

Kidneys. Combined weight 284 grams; right kidney is small. There is much perinephric induration and thickening, marked about the ureter, especially in its upper portion. The pelvis and calices of the right kidney are dilated and contain a cloudy fluid. The surface of the right kidney is fairly smooth with a few ill-defined, gray white areas both discreet and confluent. On section these areas extend for a variable distance into the renal tissue beneath. The markings of the cut surfaces are obscured. The renal cortex is narrowed. The cortex of the left kidney shows numerous small abscesses. The tissue about these, in many instances, is dark red. These areas are seen to extend into the cortical substance in the form of yellowish gray streaks. The ureter is not dilated. The bladder is negative.

Microscopic examination. One section from the right kidney shows an area of carcinoma. There are numerous areas of suppurative nephritis.

Bacteriological report. Cultures from the heart blood show scum of growth of several types of bacilli.

Sections stained for bacteria. Abscesses show only cocci; some gram-negative bacilli are found in the lymphatics and the blood stream. In the pyramidal portion of the kidney large plugs of bacteria, both cocci and bacilli, are found in the tubules.

Case 51. Autopsy No. 3352. Genito-urinary, 10-155. Male, age 28, April 25, 1914. *Past history.* Stricture of urethra for five years; internal urethrotomy three years ago. *Present illness.* For one year has had recurrent pains in right kidney without fever. For two weeks has had increased frequency followed by severe pain in region of right kidney and vomiting. His urine has been much more cloudy than previously. *Urine*, acid, cloudy, large amount of albumin, much pus and a few red blood-cells. *White blood count* 19,000. *Cystoscopy* showed cloudy urine from the right side with markedly decreased function; left kidney moderate amount of pus, 10 per cent function. *Cultures* from both kidney urines showed colon-like bacillus. *X-ray* showed right renal calculus. *Operation.* Right kidney full of small calculi, removed by pyelotomy and nephrotomy. Left kidney showed perinephric abscess with many miliary abscesses in cortex. Patient died fourteenth day. *Clinical diagnosis.* Calculus, pyelonephritis right; acute suppurative nephritis left; uræmia; and pneumonia.

Autopsy 13¼ hours post-mortem. Anatomical diagnosis: Nephrolithiasis, diphtheretic pyelitis and pyonephrosis, perinephritis with abscess formation, chronic interstitial nephritis right with chronic ureteritis, double nephrotomy with purulent infiltration of perinephric tissue, tuberculosis of the lungs, bronchopneumonia, focal necrosis of the bladder, absence of left testicle, scar of old cystotomy, fatty liver, streptococcus septicæmia.

Kidneys. Combined weight 330 grams. Abscess of perinephric tissue about each kidney. Right kidney shows adherent capsule. Surface is marked with occasional irregular depressions. In the substance of the kidney extending from the convexity to the pelvis is an irregular excavation bounded by ragged necrotic kidney tissue bathed in pus. (Nephrotomy wound.) The pelvis is moderately dilated, its mucosa covered with a dirty white layer. All the calices are dilated and contain irregular granular concretions and pus. The cortex is markedly narrowed. The left ureter is adherent to the surrounding tissue. Its mucosa is smooth. The right kidney has an adherent capsule, on removal of which, several cavities filled with yellow pus are exposed. There are numerous pinhead sized abscesses on the surface. In the substance of the kidney extending into the pelvis is an irregular cavity bounded by necrotic tissue. (Nephrotomy wound.) The renal pelvis is moderately dilated and filled with pus, two concretions. The mucosa of the pelvis shows an adherent dirty layer. The left ureter is not remarkable. The bladder and prostate are normal.

Microscopic examination. One section of the kidneys shows suppurative nephritis, another section shows atrophy and a round cell infiltration. At the tip of the pyramids in one section is necrosis and purulent infiltration.

Bacteriological report. Cultures from the heart blood show profuse growth of colon-like bacilli and cocci. *Sections stained for bacteria.* In the section preserved there were no abscesses and small evidence of suppuration. Many staphylococci and a few gram-negative bacilli were found in the pelvis.

Case 52. Surgical Case No. 8127. East Surgical, 596-207. Female, age 25. January 9, 1908. *Past history.* Painful micturition since childhood. *Present illness.* Four days of right-sided abdominal pain with vomiting, later pain localized in right kidney region, urine became cloudy. *Urine* at admission alkaline, slight trace of albumin, much pus. *Temperature* 103°. *White blood-cell* count 15,600. *Physical examination* showed a mass similar to appendix abscess and thought to be that. *Operation.* Exploratory laparotomy and nephrectomy for acute infected kidney. Uneventful recovery. *Cultures*, peritoneal fluid, no growth, pus from kidney abscess shows few cocci and bacilli. *Clinical diagnosis.* Acute infected kidney.

Pathological report. Kidney very much enlarged. On the surface multiple small purulent foci; on section the same are seen in the cortex of the kidney, more rarely in the papilla.

Microscopic examination. Infiltration with round and pus-cells and destruction of the tubules especially in small foci.

Sections stained for bacteria. No true cortical abscesses found in tissue. The picture is more that of a colon bacillus pyelonephritis with tubules the center of suppuration. Bacteria found in these areas show mixed infection of staphylococci and gram-negative bacilli, the latter predominating.

CASE 53. Surgical Case No. 710–117. South Surgical, 154–1. Female, age 34, October 19, 1907. *Present illness.* Eight days ago onset of abdominal pain in region of appendix with fever which quickly subsided leaving soreness in region of kidney. *Physical examination.* Right kidney palpable and tender. *X-ray* negative. *Urine* at entrance acid, slight trace of albumin, some pus. *White count* 7,300. Guinea-pig inoculation negative for tuberculosis. *Operation,* Nephrectomy. Kidney slightly enlarged, pale, few areas of discoloration. It was thought to be the cause of the trouble and removed. *Clinical diagnosis.* Colipyelonephritis. Recovery.

Pathological report. Enlarged soft kidney with opaque yellow stripes and dots in the pyramids surrounded by reddened zones.

Microscopic examination. Foci of round-cell infiltration in many places with intense congestion of surrounding vessels. Epithelium of the tubules swollen, desquamated, and the lumen filled with hyaline and granular casts. *Culture* from the kidney tissue at operation, colon bacillus.

Sections stained for bacteria. Considerable number of gram-negative bacilli in the tubules and pelves with a typical picture of colon pyelonephritis. Here and there in the cortical region are small abscesses with a mixed infection of gram-negative bacilli and large numbers of staphylococci.

NOTE.—A colon pyelonephritis with superimposed staphylococcus abscess.

CASE 54. Autopsy No. 2164. West Surgical, 595–261. Female, age 54. May 28, 1908. *Past history.* Marked constipation for four months, *Present illness.* For five days acute abdominal left-sided pain with chills and fever; temperature of 102–104° with pusy urine.

Two days ago acute tender red mass appeared in the left kidney region. *Urine,* acid, very slight trace of albumin, small amount of pus, microscopic blood. *White blood count,* 22,000. Culture from the urine shows colon-like bacilli. *Operation,* nephrotomy for septic kidney. Kidney considerably and symmetrically enlarged, soft and pulpy with scattered small abscesses of the cortex. Pelvis not dilated. Patient died 10 days after admission, fourth day after operation. *Clinical diagnosis.* Septic kidney.

Autopsy 7¼ hours post-mortem. Anatomical diagnosis: Carcinoma of vagina with obstruction and dilatation of left ureter; left ureteritis, pyelitis and suppurative nephritis, nephrotomy wound, streptococcus septicæmia.

Kidneys. Right kidney weighs 171 grams. Capsules strip with some difficulty, leaving a granular surface. Cortex measures 6 millimeters. Markings are fairly distinct. There are no abscesses in the right kidney. Right ureter is not remarkable. Left kidney weighs 208 grams; perinephric fat separated from the kidney and the space is filled with bloody purulent material. On the convexity of the kidney there is an irregular opening 6 centimeters in length leading into the pelvis. The walls of this cavity are composed of soft necrotic kidney tissue. At various places in the cortex and extending into the pyramid the kidney tissue is transformed into a soft, yellowish black, semi-fluid material. These areas are wedge-shaped with free pus at the surface. Generally they are sharply outlined from the surrounding renal tissue. The surface of the cortex where not involved in the above-mentioned necrotic area about the wound shows indistinct markings. There are no abscesses of the kidney. The mucosa of the pelvis and ureter are reddened and the lumen contains purulent areas. The lower half of the ureter is dilated, and its lower end is pressed upon by a tumor mass.

Microscopical examination shows acute degenerative change with suppuration.

Bacteriological report. Cultures of the heart blood and spleen show streptococcus and colon-like bacillus.

Sections stained for bacteria. There are chains of streptococci in small arteries and in the capillaries of the glomeruli. There are a few clumps of streptococci and gram-negative bacilli in the straight collecting tubules. There are also a few bacilli in the blood stream.

CASE 55. Autopsy No. 880. West Medical, 570–6. Male, age 51, May 28, 1902. *Present illness.* Six months weakness, some nausea, occasional vomiting, restlessness at night, loss of appetite, nocturia three or four times, slight frequency. Has a history of hæmaturia once within that period. *Physical examination.* Redness and tenderness with some œdema of outer and under side of both thighs and buttocks. *Temperature* normal at entrance. White blood cell count 48,000. *Urine,* bloody, acid, small trace of albumin; sediment, much blood, few cell-casts, moderate number of leucocytes. Patient began to run a septic temperature which reached 102°, became unconscious and died fifth day. *Clinical diagnosis:* Erysipelas.

Autopsy 19¼ hours post-mortem. Anatomical diagnosis: Suppurative nephritis with infarcts of the kidney, subacute glomerular and chronic interstitial nephritis, suppurative prostatitis, seropurulent peritonitis, soft spleen, mural thrombi in the right auricle and the right ventricle, thrombi in the right common iliac and right femoral veins, arteriosclerosis with small secondary aneurysm of the left coronary artery, hæmorrhagic œdema of the inferior lobe of the left lung, streptococcus infection.

Kidneys. Capsules free. Surfaces show numerous minute yellow points. The glomeruli do not

appear to be abnormal. On section, the areas above described are found to extend through the cortex and into the pyramid in some cases as grayish yellow lines. Bladder and ureters not remarkable. Prostate shows numerous small abscesses.

Microscopic examination. In many places the interstitial tissue of the kidneys is increased in amount over small areas and there is atrophy of the renal element and round-cell infiltration. In a good many tubules pus-cells and necrotic desquamated epithelial cells are present. In one section two abscesses are observed. The capillaries of some of the glomeruli contain leucocytes. In a minority of the glomeruli there are vesicular nucleated cells closely packed together which are proliferated epithelium of the glomerular capsules. There is considerable œdema of the interstitial tissue.

Bacteriological report. Cultures from the heart blood, no growth. Cultures from the liver and spleen, profuse growth of bacteria, mostly staphylococcus.

Sections stained for bacteria. Staphylococci among which are some chains of streptococci are found in the small areas of suppuration. There are also a few bacilli.

CASE 56. Autopsy, No. 1505. East Surgical, 522–119. Male, age 69. September 19, 1905. *Past history.* Gonorrhœa 47 years ago. Stricture 16 years later, operation, divulsion of stricture at that time. *Present illness.* Admitted with retention. *Urine*, acid, slight trace of albumin, much pus. *Temperature* normal. *Operation.* Perineal section. Twenty days after operation developed temperature and symptoms thought to be right pleurisy, patient refused nourishment, began to vomit, had partial suppression of urine, and died on the forty-sixth day. *Clinical diagnosis:* Stricture of urethra.

Autopsy 33 hours post-mortem. Anatomical diagnosis: Stricture of urethra, perineal sinus, slight hypertrophy of prostate, hypertrophy of bladder with diverticula and cystitis, diphtheritic ureteritis, pyonephrosis, diphtheritic pyelitis and suppurative nephritis on the left, senile atrophy of right kidney, hypostatic pneumonia.

Kidneys. Left renal pelvis and calices dilated and filled with foul, thick fluid. Adherent to the walls of the calices and pelvis is a grayish pink membrane. The capsule of the left kidney is adherent, surface is extremely granular. Here and there on the surface are whitish slightly elevated areas 2 to 3 millimeters in diameter, containing pus. The cortex is thinned. The right kidney shows slightly adherent capsule. The pelvis of this kidney is slightly enlarged, otherwise negative. The right ureter is negative.

No microscopical examination of the kidney is recorded; no autopsy cultures.

Sections stained for bacteria. No kidney tissue was preserved, section of prostate used. The miliary abscesses in the prostate show staphylococci, a few chains of streptococci, and many bacilli.

CASE 57. Autopsy No. 1197. West Surgical, 465–67. Male, age 40. March 15, 1904. *Present illness.* Fracture of vertebra of twenty-four hours standing. *Urine*, on entrance, small trace of albumin, a few finely granular and epithelial cell-casts, leucocytes. *Operation.* Laminectomy. No other urinary examination recorded. From entrance patient ran an increasingly high temperature and died twentieth day. *Clinical diagnosis:* Fracture of dorsal vertebra.

Autopsy 72 hours post-mortem. Anatomical diagnosis: Fracture first lumbar vertebra, crushed cord, operation wound — laminectomy, septic wound; meningitis, abscess of right lung, double empyæmia, abscesses of kidney and prostate, cystitis, Pott's fracture of left leg, streptococcus septicæmia.

Kidneys. Combined weight 365 grams. Capsules easily removed revealing small abscesses on the surfaces of both kidneys. In places these abscesses extend a distance into the cortex and in a few instances as streaks as far as the tips of the pyramids. The kidneys are not dilated, ureters are free. The bladder presents an ecchymotic gray red mucosa. The prostate shows an abscess 3 centimeters in diameter, of the right lobe.

Microscopic examination. Sections of the kidney show abscesses.

Bacteriological report. Cultures from the heart, liver and spleen show staphylococci and streptococci. *Cover glass preparations* from the pus in the wound show streptococci. *Sections stained for bacteria.* Abscesses in the kidney tissue show clumps of streptococci and staphylococci. In one abscess there are two large masses of bacteria, one of which seems entirely a streptococcus infection, the other entirely a staphylococcus infection.

CASE 58. Autopsy No. 1731. West Medical, 644–161. Female, age 32. June 30, 1906. *Past history.* Four years ago post-puerperal sepsis. *Present illness.* One week ago began to have recurrent attacks of chills without other symptoms. Patient came to hospital in prostrated condition; high temperature, pulse, and respiration. *Urine*, very slight trace of albumin, moderate number of red blood and pus-cells. *White count* 13,000. Patient continued to grow worse and died fourth day. *Clinical diagnosis:* Septicæmia, origin unknown.

Autopsy 19 hours post-mortem. Anatomical diagnosis: Malignant endocarditis of mitral valve, bronchopneumonia, purpura hæmorrhagica, infarcts of spleen and kidneys, suppurative nephritis, septicæmia staphylococcus pyogenous aureus, early pregnancy and abortion.

Kidneys. Combined weight 329 grams. The capsules strip easily leaving a dark reddish surface dotted over with minute yellow points, dark red spots and here and there small irregular confluent abscesses. The small yellow areas mentioned are seen to be the outer surface of fairly firm homogeneous masses surrounded by blackish red kidney tissue from which they are sharply marked off. In

some places these infarcts are situated in the cortex, while in others a few extend from the bases of pyramids to the cortex. In the pyramids are to be found numerous yellow streaks and spots. The cortex measures 5 to 6 millimeters. The mucosa of the pelvis shows minute blackish red spots. Ureters and bladder normal save for few ecchymotic areas.

Microscopic examination. The kidneys show necrosis with abscesses and hæmorrhage.

Bacteriological report. Cultures from the heart blood and spleen show pure growth of staphylococcus pyogenes aureus. *Sections stained for bacteria* show in the discreet abscesses mixed infection of streptococci and staphylococci. In many places the vessels are found plugged with bacteria most of which are streptococci, although all were found to contain considerable numbers of staphylococci.

CASE 59. Autopsy No. 1081. South Surgical 79–97. Female, age (?) June 26, 1903. *Present illness.* One week of acute abdominal pain with high fever finally localizing in the gall-bladder region. *Urine,* neutral reaction, trace of albumin, occasional blood and pus-cells, no casts. *White blood count* 80,000; *temperature* varied from 100 to 104°. Patient was not operated on, and died of sepsis on seventh day. *Clinical diagnosis:* Cholelithiasis, cholecystitis, suppurative nephritis.

Autopsy 4¾ hours post-mortem. Anatomical diagnosis: Pyonephrosis, pyelonephritis, cholelithiasis, icterus, fibromyoma of the uterus.

Kidneys. Left kidney is apparently normal, right kidney is enlarged, and its capsules strip leaving a smooth surface, dotted here and there with minute yellowish abscesses. On section the tissue is soft and section surface shows numerous minute purulent areas. The cortex is of good width; the pelvis is dilated and contains yellowish brown, foul, purulent material. Ureters and bladder show nothing remarkable.

Microscopic examination. Sections of the kidney show the usual appearance of pyelonephritis. Sections of the left kidney show only œdema.

Bacteriological report. Cultures from liver and spleen show scum of growth of bacilli.

Sections stained for bacteria show considerable numbers of gram-negative colon-like bacilli in the arteries and in some of the tubules while a considerable number of a smaller gram-positive bacillus are to be found in abscess areas.

CASE 60. Autopsy No. 285. East Surgical, 338–116. Male, age 80, June 14, 1898. *Present illness.* Patient admitted for retention. Could give no information about himself. *Temperature,* 100°; vomiting, died soon after entrance. *Clinical diagnosis:* Enlarged prostate.

Autopsy 19 hours post-mortem. Anatomical diagnosis: Adenoma prostate, diverticulum bladder, slight dilatation ureters, suppurative nephritis, arteriosclerosis, senile emphysema lungs, papillary adenoma kidneys.

Kidneys. Capsules somewhat adherent. Cortex of each kidney somewhat narrowed. Kidney tissue pale, opaque, and soft. A few small abscesses beneath the cortex (Fig. 32). Cultures of the heart blood show no growth. *Cultures* from the kidney show several varieties of cocci and bacilli which are not differentiated.

Microscopic examination. Kidney shows in the cortex extensive areas of infiltration of leucocytes with some disintegration of the renal epithelium. Glomeruli are not remarkable. Arteriosclerosis of the vessels, some areas of fibroid atrophy and round-cell infiltration.

Sections stained for bacteria. The predominating organisms in the abscess cavities are two types of bacilli, one a gram-negative bacillus probably bacillus coli, the other a long barred gram-positive bacillus.

NOTE.— These two bacilli clearly seem the etiological factors in the production of suppuration although occasionally cocci are found. This case shows considerable post-mortem invasion which may explain the presence of the variety of organisms found, yet the occurrence of the two bacilli described above in large numbers and confined to abscess cavities seems to indicate that they are the etiological factors.

THE LESIONS OF SO-CALLED ASCENDING INFECTION ARE HISTOLOGICALLY INDISTINGUISHABLE FROM THE EXCRETORY TYPE OF LESION

It has been customary to assume that there was a definite lesion produced in the kidney by ascending infection. This is referred to again and again in the literature and is often spoken of as the typical lesion of ascending infection. That this distinction cannot be maintained appears to us to be conclusively shown by the two following cases (32 and 33): Without reproducing here the whole evidence printed above we may note that Case 32 was that of a man whose urine was normal at the time of entrance to the hospital. Following operation for cancer of the stomach, retention of urine took place and he was catheterized regularly until the day of his death three weeks later. During the process of catheterization, pus appeared in the urine and the case is typical of those generally credited with being ascending infection. Case 33 was that of a woman, interestingly enough of exactly the same age, who died two weeks after an operation for fibroma of the uterus followed by infection of the wound. This patient had no urinary infection at the time of entrance, was not catheterized during her stay in the hospital and at autopsy showed a normal bladder. Nevertheless the lesions of the

kidneys in these two cases are indistinguishable as a glance at the illustrating figures will show. These cases are typical of several occurring in our experience and we think they are sufficient to require an abandonment of the belief that there is any lesion of the kidney typical of ascending infection.

THE BEARING OF THE ABOVE OBSERVATIONS UPON THE DIAGNOSIS OF RENAL INFECTIONS

If we have succeeded in establishing the fact that the pyogenic organisms produce lesions of the kidney essentially different from those produced by non-pyogenic organisms, it follows that this fact has an important bearing upon diagnosis. In the first place it has, we think, been abundantly demonstrated by the testimony of many observers that organisms concerned in renal infections appear promptly in the urine though they may not long continue to so appear. That organisms not concerned in renal infections may also appear in the urine is to be remembered. The evidence above referred to of the appearance of tubercle bacilli and lepra bacilli after the administration of salvarsan, the recent observations of William H. Smith in regard to the appearance of organisms in the urine of patients with fever probably caused by a septicæmia, and a mass of extremely careful evidence all bear upon this point.

On the other hand, with clinical evidence suggesting a renal infection, the diagnostic importance of a careful examination of the urine can hardly be overestimated. Thus the lesions characteristic of pyogenic organisms will show the bacteria in the urine perhaps only during the early stages. Since, however, these lesions are comparatively shut off from the lower portions of the kidney and as they do not involve the pelvic mucous membrane, pus in any considerable amount, will be found rarely if at all. By the same token, since the lesions of the nonpyogenic group are produced chiefly in the renal pelvis, evidence of this fact is abundantly clear in the urine by the early production of pus accompanying the appearance of the microorganisms.

A very striking difference is also to be observed in the effect on kidney function as measured by phthalein of these two types of infection. Since the suppurative infections involve chiefly the cortex and comparatively little the convoluted tubules, they would be expected to produce comparatively little effect upon kidney function thus measured, and such is in fact the case. On the contrary the chief lesion of acute renal infections with the colon bacillus group is first upon the convoluted tubule, the pelvic lesion though appearing early being we think secondary to the tubular lesion. This should and in fact does produce sudden and profound changes in kidney function, the case described on p. 498 being but one of a considerable series of observations which we have previously discussed in a paper on "Pyelonephritis."[1] Briefly and somewhat dogmatically stated therefore, the diagnostic evidence is as follows: If with clinical evidence suggesting a renal infection, freshly drawn urine studied as suggested by Crabtree[2] shows cocci in abundance with a small amount of albumin, a few red blood-corpuscles and many leucocytes or a little pus, together with a renal function at or near normal limits, a diagnosis of coccus infection of the kidney is justified. If, on the other hand, a similar examination shows many bacilli, a little albumin and much pus coupled with a markedly diminished kidney function, a diagnosis of colon bacillus infection of the kidney is unavoidable.

Though it is foreign to the title of this paper, it may not be improper to suggest the bearing of these observations upon treatment. Clearly the suppurative lesions concern those portions of the kidney which are relatively inaccessible to drugs and if these lesions are such as to require treatment, that treatment must be operative. On the other hand, the lesions produced by the colon bacillus group concern those portions of the kidney relatively accessible to formaldehyde containing drugs, and the surgeon is therefore justified in persisting in treatment by this method on the assumption that if it be properly planned and efficiently carried out

[1] Boston M. & S. J., 1916, June, 1.
[2] Surg., Gynec. & Obst., 1916, xxii, 221.

it will succeed in controlling the infection. This statement must not be assumed to mean that we believe that the formaldehyde containing drugs act upon the cells of the convoluted tubules. This we have no reason to assert, but the lesion of this portion of the kidney is a very transient one and such damage as is done by the acute process is rapidly overcome by the restorative action of the cells themselves. This particular lesion does not require treatment. It is the lesion of the pelvis and to some extent of the lower urinary tract that is the persistent and dangerous lesion, and this can be reached by formaldehyde.

NOTE.— We wish to express appreciation of the valued services of Dr. James Homer Wright director of the laboratory for a lively interest in the work and for aid in collecting material. We have appreciated the privilege of appealing to his judgment on difficult questions arising during the progress of the work.

Dr. Oscar Richardson has kindly supplied from the autopsy room much valuable material.

Dr. William H. Smith has offered many helpful suggestions on the staining of bacteria in tissue.

Whatever of unusual merit our microphotographs may show is due to the painstaking, thorough work of Mr. L. S. Brown.

BIBLIOGRAPHY

ALBARRAN, J. Étude sur le rein des urinaires. Theses de doct., Par., 1889, p. 184.

ALBARRAN and HALLE. Note sur une bactérie pyogene et sur sone rôle dans l'infection urinaire. Bull. Acad. de med., Par., 1888, p. 310.

ARBRITER. Ueber Permeabilitie der normal Darmwand fuer kleine Korpfchen. Virchow's Arch. f. path. Anat., 1910, p. 321.

BAHR, L. Untersuchungen ueber die Aetiologie der Cholera infantum. Centralbl. f. Bakteriol., 1912, xlvi, 335.

BARTH. Die eitrigen nichttuberkulosen Affektion der Niere. Verhandl. d. deutsch. Gesellsch. f. Urol., 1909, ii, 227; discussion, 246.

BAUEREISEN, A. Beitrag zur Frage der aszendierenden Nierentuberkulose. Ztschr. f. gynaek. Urol., 1910, ii, 132.

BIEDL, A., and KRAUS, R. Ueber die Ausscheidung der Mikroorganismen durch die Niere. Arch. f. exp. Path. u. Pharm., 1896, xxxvii, 1.

BOND, C. J. On ascending currents in mucous canals, and gland ducts, and their influence on infection: a study in surgical pathology. Brit. M. J., 1905, ii, 232.

BREWER, G. E. The pathology, diagnosis, and treatment of acute unilateral septic infarcts of the kidney. N. Y. M. J., 1907, lxxxv, 1013.

IDEM. A rare type of unilateral hematogenous infection of the kidney. Yale M. J., 1911, xvii, 237.

IDEM. The present state of our knowledge of acute renal infections. J. Am. M. Ass., 1911, lvii, 179

IDEM. Acute hæmatogenous infection of the kidney. Am. J. Urol., 1913, ix, 549.

BROWN, L. The significance of tubercle bacilli in the urine. J. Am. M. Ass., 1915, lxiv, 886.

BUDAY, K. Experimentell-histologische Studien ueber die Genese des Nierentuberkels. Virchow's Arch. f. path. Anat., 1906, clxxxvi, 145.

CHAMBARD, E. Guérison spontanée de la pyélite aigue. Ann. d. mal. d. org. genito-urin., 1911, i, 865.

CHURCHMAN, J. W. Notes on the examination of the urine for tubercle bacilli (tb. in urine in miliary tuberculosis). Am. J. M. Sc., 1914, cxlviii, 722.

CLARKE, W. B. Paths of infection of the urinary tract. Clin. Jour., 1911, xxxviii, 177.

CONRADI, H., and BIERAST. Ueber Absonderung von Diphtheriekeimen durch den Harn. Deutsche med., Wchnschr., 1912, xxxviii, 1580.

CUNNINGHAM, J. Acute unilateral hematogenous infection of the kidney. Ann. Surg., Phila., 1912, lvi, 818.

CUTURI, F. Contribution clinique et experimentale a l'etude de l'action du bacterium coli sur lere in. Ann. d. mal. d. org. genito-urin., 1911, xxix-1, 515, 528.

DRAPER, J. W., and BRAASCH, W. F. The function of the ureterovesical valve. J. Am. M. Ass., 1913, lx, 20.

EISENDRATH, D. N., and KAHN, J. V. The rôle of the lymphatics in ascending renal infection. J. Am. M. Ass., 1916, lxvi, 561.

FAHR, T. Kœnnen wir die Nierenkrankungen nach ætiologischen Gesichts-punktenein teilen? Virchow's Arch. f. path. Anat., 1912, ccx, 227.

FRANKE, C. Etiologie der Koli Infektionen. Arch. f. Anat. u. Physiol., 1910, 1911; Berl. klin. Wchnschr., 1911, xlviii, part 2, 1973.

FREIFELD, E. Ueber das Vorkommen von Diphtheriebacillen im Harn. Berl. klin. Wchnschr., 1913, l, part 2, 1761.

FRISCH, v. Die eitrigen, nicht tuberkuloesen affektionen des Nierenbeckens. Verhandl. d. deutsch. Gesellsch. f. Urol., II Kongress, 1909, ii, 191.

GRAFF, H. Die Koliinfektion der Nieren und ihre Behandlung. Ztschr. f. urol. Chir., 1914, III, 6.

HESS, O. Experimentelle Untersuchungen ueber die Bacterium coli-Infektion der Harnorgane. Mittl. a. d. Grenzgeb. d. Med. u. Chir., 1913, xxvi, 135.

HEYN, A. Ueber disseminierte Nephritis bacillaris Tuberkuloese ohne Nieren-Tuberkel. Virchow's Arch. f. path. Anat., 1901, clxv, 42.

HONEIJ, J. J. Leprosy — presence of acid-fast bacilli in circulating blood and excretions. J. Infect. Dis., 1915, xvii, 376.

JAHN, E. Ueber die Ausscheidung von Bakterien durch den Harn and die bakterizide Wirkung desselben. Centralbl. f. Bakteriol., 1910, lv, 276.

JEFFREYS, WM. Infection of the urinary tract in children by coliform organisms. Quart. J. Med., 1910, iv, 268.

KODAMA, H., and KRASNOGORSKI, N. Bakteriologische Befunde bei Erkrankungen der extra-renalen Harnwege bei Kindern und Erwachsenen. Centralbl. f. Bakteriol., 1913, lxix, 8.

KOLL, I S. An experimental and clinical study of colon bacillus infections of the urinary tract. Tr. Am. Urol., Ass., 1911, v, 94.

IDEM. Further experience with aluminum acetate in colon liquor bacillus infection of urinary tract. Ibid, 1912, vi, 242.

KOWITZ. Ueber bakterielle Erkrankungen der Harnorgane im Sauglingsalter (sog. Pyelocystitis). Jahrb. f. Kinderh., 1915, lxxxii, 309.

KRAEMER, C. Experimentelle Beitraege zum Studium der Hodentuberkulose. Verhandl. d. pathol. Gesellsch., 1898–1900, i-3, iii Tagung, Berl., 1901, p. 94.

KUMITA. Ueber die Lymphgefaessen der Nieren und Nebennierenkapsel. Arch. f. Anat. u. Physiol., 1909 Anat. Abth., p. 49.

LEMIERRE, A., and ABRAMI, P. L'infection descendante des voies urinaires, dans la fièvre typhoide. J. d'urol., med., et chir., 1912, ii, 21.

LUCAS. Study of peristaltic movements of the ureter by the graphic method. Am. J. Physiol., 1906, xviii, 392.

LEUTSCHER, J. A. Infection of the urinary tract by the bacillus lactis aerogenes, with a consideration of the mode of entrance of bacteria into the bladder. Bull. Johns Hopkins Hosp., 1911, xxii, 361.

MACGOWAN, G. Hematogenous kidney infections. J. Am. M. Ass., 1915, lxiv, 226. (Extensive bibliography.)

MAYER, A. Die beziehungen der Koli-pyelitis zur Fortplanzungstaetigkeit. Muenchen. med. Wchnschr., 1913, xl, 1479.

MEYER-BETZ, F. Ueber primaere Colipyelitis. Deutsch. Arch. f. klin. Med., 1911, cv, 531.

MEYER, E. Ueber Ausscheidungstuberculose der Nieren. Virchow's Arch. f. path. Anat., 1895, cxli, 414.

MUELLER, A. Untersuchungen ueber die Ausbreitung des entzuendlichen Processes im Nierenparenchym, etc. Arch. f. klin. Chir., 1912, xcvii, 44.

OPPENHEIMER. Les pyélites. Rev. clin. d. urol., 1913, p. 172.

ORTH, J. Path. Anat., 1893, ii, part 1, 65.

PATRICK, A. Remarks on typhoid bacilluria: with a description of certain atypical coli-typhoid bacilli found in the urine in enteric fever. J. Path. & Bacteriol., 1913, xviii, 365.

PROCHASKA, PIERO. Pneumococcus Septicemia. Zentralbl. f. inn. Med., 1900, lxxi, 1145; also Arch. f. klin. Med., 1901, lxx, 559.

RÁSKAY, D. Die Rolle des Influenzabacillus bei Erkrankungen des Urogenitalapparate. Virchow's Arch. f. path. Anat., ccxiii, 511.

RATHERY, F. Le tube contourné du rein, étude histologique anatomo-pathologique experimentale. Thesis de doct., Par., 1905, 230.

REHN, L. Ueber die Fruehdiagnose und Fruehoperation der metastatischen Eiterung in der Nierenfettkapsel. Beitr. z. klin. Chir., 1911, lxxiii, 1.

ROLLY, F. Zur Frage der Durchgaengigkeit der Niere fuer Bakterien. Muenchen. med. Wchnschr., 1909, lvi, 1873.

ROSENOW, E. C. Pneumococcus septicæmia. J. Am. M. Ass., 1905, xliv, 871.

ROVSING, T. Ueber die Aetiologie, Pathogenese, und Behandlung der septischen Infectionen der Harnwege. Monatshr. d. Harn. u. Sex. Apparat, 1898, iii, 505.

IDEM. Erwiderung auf die Bemerkungen von Dr. Krogius ueber die Bakteriurie. Centralbl. f. d. Krankh. d. Harn. u. Sex-Org., 1899, x, 413.

IDEM. Klinische und experimentelle Untersuchungen ueber die infektiosen Krankungen der Harnorgane. Berlin: 1898.

SAKATA, K. Ueber den Lymphapparat des Harnleiters der Nieren. Arch. f. Anat. u. Physiol., 1903, Anat. Abth., i, 1.

SCHEIDEMANDEL, E. Die infektioesen Erkrankungen der Nieren und Harnwege. Wurz. Abhandl. a. d. Gsmtgeb. d. prakt. Med., 1913, xiii, 179.

SCHNITZLER, J. Ueber metastatische Eiterungsprozesse in der Niere und um die Niere. Wien. med. Wchnschr., 1913, lxiii, 2551.

SIMONS, I. Bacterial endocarditis. Quart. J. Med., 1913, vii, 291. (Pathology of kidneys, good.)

SUGIMURA, S. Ueber die Beiteiligung der Ureteren an den akuten Blasenentzuedungen, u.s.w. Virchow's Arch. f. path. Anat., 1911, cvi, 20.

SUTER, F. Zur Aetiologie der infektioesen Erkrankungen der Harnorgane. Ztschr. f. Urol., 1907, i, 97; 207; 327. (p. 125, Faelle von endogener Infektion der Harnwege mit Colibakterien, of value.)

SWEET, J. E., and STEWART, L. F. Ascending infection of the kidneys. Surg. Gynec., & Obstet., 1914, xviii, 460.

THIELE and EMBLETON. Infection: paths of spread in bacterial infection. Proc. Roy. Soc. Med., Lond., 1913, vii, p. 69.

THOMSON, JOHN. On acute pyelitis due to bacillus coli as it occurs in infancy. Quart. J. Med., 1909, iii, 251.

TIETZE, A. Die pyogene Niereninfektion. Berl. klin. Wchnschr., 1912, xlix, 49.

TWORT, C., and CRAIG, T. The pathogenecity of Johne's bacillus. Centralbl. f. Bakteriol., 1913, lxviii, 455.

WALKER, J. W., THOMSON. Acute pyelitis, pyelonephritis, suppurative nephritis. Practitioner, Lond., 1911, lxxxvi, 655.

WIDAL, F., and BÉNARD, R. Pyélonéphrite gravidique descendante par septicémie colibacillaire. J. d'urol., med., et chir., 1912, i, 317.

WULFF, O. Das Bacterium Coli und sein Auftreten in den Harnwegen. Centralbl. f. Bakteriol., 1912, lxv, 27.

WYSSOKOWITSCH, W. Ueber die Passierbarkeit der kranken Nieren fuer die Bakterien. Ztschr. f. Hyg. u. Infektionskrankh., 1908, lix, 1.

IDEM. Ueber die Schicksale der in's Blut injicierten Mikroorganismen usw. Zeitschr. f. Hyg., 1886, i, 3. For references to Maas, Rutimeyer, Wiener, Cohmheim, Wyssokowitsch, Cocordi, Pernice and Scagliosi, Sherrington and Cotton, see Biedl and Kraus, Arch. f. exp. Path. u. Pharmakol., 1896, xxxvii, 1, and Jahn, Centralbl. f. Bakteriol., 1910, lv, 276.

THE BASTEDO SIGN IN CHRONIC APPENDICITIS

By JACOB ROSENBLOOM, M.D., Ph.D., Pittsburgh

In 1911 Bastedo (1) described a new test for chronic appendicitis. It consists in passing a colon tube eleven to twelve inches into the rectum and injecting air by means of an atomizer bulb. He found that as the colon distends, pain and tenderness to finger-point pressure becomes apparent at McBurney's point, if appendicitis is present. Dreyer (2), Rost (3), Slawinski (4), Hertz (5), Goodman and Lueders (6), and Bischoff (7) have described their experiences with this test.

Bastedo, Hertz, Dreyer, and Bischoff consider colonic inflation of great value as a diagnostic sign of chronic appendicitis. Rost, however, claims that Bastedo's sign is positive not only with diseases of the appendix but also in pathologic conditions in the colon. Rost also says that the pain appears only if there are changes in the mesenteriolum which brings the appendix into a certain abnormal relation to the cæcum; however, Bischoff on the contrary has found the test positive when the mesenteriolum was entirely normal and the appendix alone was diseased. In the cases that he examined after operation, there was no longer the slightest pain in the appendix region when the colon was distended.

Goodman and Lueders, however, claim that there is no constancy in the results obtained with this test, and it is in no sense pathognomic of chronic appendicitis. They have seen no positive reactions in normal individuals.

I have personally been using this test, ever since its description by Bastedo and have found it of great service in the diagnosis of chronic appendicitis as may be readily noted by the accompanying tabulation of cases studied.

Case No.	Clinical Diagnsois	Bastedo Sign	Operative Findings
1	Normal	Negative	.....
2	Normal	Negative	.....
3	Normal	Negative	.....
4	Normal	Negative	.....
5	Normal	Negative	.....
6	Normal	Negative	.....
7	Normal	Negative	.....
8	Normal	Negative	.....
9	Normal	Negative	.....
10	Normal	Negative	.....
11	Chronic appendicitis	Positive	Chronic appendicitis
12	Chronic appendicitis	Positive	Chronic appendicitis
13	Chronic appendicitis	Positive	Chronic appendicitis
14	Chronic appendicitis	Positive	Chronic appendicitis
15	Chronic appendicitis	Positive	Chronic appendicitis
16	Chronic appendicitis	Positive	Chronic appendicitis
17	Chronic appendicitis	Positive	Chronic appendicitis
18	Chronic appendicitis	Positive	Chronic appendicitis
19	Chronic appendicitis	Positive	Chronic appendicitis
20	Gastric ulcer	Negative	Gastric ulcer
21	Duodenal ulcer	Negative	Duodenal ulcer
22	Bilateral salpingitis	Negative	Salpingitis
23	Cholelithiasis	Negative	Cholelithiasis
24	Nephrolithiasis	Negative	Nephrolithiasis
25	Pyonephrosis	Negative	Pyonephrosis
26	Gastric ulcer	Negative	.....
27	Gastric ulcer	Negative	.....
28	Pyloric adhesions	Negative	Adhesions
29	Pyloric stenosis (luetic)	Negative	.....
30	Lues with gastric symptoms	Negative	Symptoms cured by Salvarsan
31	Chronic appendicitis	Positive	Chronic appendicitis
32	Chronic appendicitis	Positive	Chronic appendicitis
33	Chronic appendicitis	Positive	Chronic appendicitis
34	Chronic appendicitis	Positive	Chronic appendicitis
35	Chronic appendicitis	Positive	Chronic appendicitis
36	Nephroptosis	Negative	Nephroptosis
37	Gastric ulcer	Negative	Gastric ulcer
38	Duodenal ulcer	Negative	.....
39	Ectopic pregnancy (right side)	Negative	Ectopic
40	Salpingitis	Negative	Salpingitis

I am convinced that this sign is of great value in the diagnosis of chronic appendicitis.

REFERENCES

1. Bastedo. Am. J. M. Sc., 1911, cxliii, 11; N. Y. St. J. Med., 1909, November.
2. Dreyer. Muenchen. med. Wchnschr., 1912, 1845.
3. Rost. Muenchen. med. Wchnschr., 1912, p. 2055.
4. Slawinski. Muenchen. med. Wchnschr., 1912, p. 2055.
5. Hertz. Lancet, Lond., 1913, i, 816.
6. Goodman and Lueders. Am. J. M. Sc., 1914, cxlviii, 357.
7. Bischoff. Monatschr. f. Geburtsh. u. Gynaek., 1915, xl, No. 3.

SOME OBSERVATIONS CONCERNING POST-OPERATIVE COMPLICATIONS OF THE LANE SHORT CIRCUIT AND COLECTOMY

By REA SMITH, M.D., Los Angeles, California

THE intestinal work of Sir Arbuthnot Lane has been widely criticized in this country with varying degrees of justice, depending upon the knowledge of the writer or speaker upon the subject and his experience in dealing with these cases.

If it be possible to summarize the opinions of surgeons on the subject of relief of intestinal stasis by surgery, I would say that it can be expressed in this: "There is no doubt that certain cases are greatly relieved of their symptoms of intoxication by one of the Lane procedures, but the result of the operation is too often spoiled by complications which arise from the surgery itself."

In this paper I shall take up separately the complications that seem to be peculiar to this particular type of surgery and attempt to point out the reasons for their occurrence and the logical way to avoid them.

In ileocolostomy, the one great fear of American surgeons has been the backing up of fæces into the blind pouch of the cæcum, necessitating secondary colectomy. Lane's records in 1912 showed that this complication happened in 20 per cent of his own cases, and that he was unable to foretell in which case it might be expected. A more careful consideration of the *physiology* of the colon will show that the remedy for this, the greatest bugbear of the short circuit, lies not in finding some method to prevent the ileal content from going back into the cæcum, but in assuring this content a free outlet after it has backed up. The ileal content in all successful short-circuit cases backs up into the blind pocket, and the only ones that become impacted are those with a partially obstructed colon from which the solid residue cannot return.

It has been repeatedly shown by the X-ray that any fluid thrown into the terminal segment of the large bowel will be carried immediately into the cæcum by reverse peristaltic waves. Here the fluid is absorbed and the so-called normal peristaltic waves carry the more solid content back to the lower segment or container. This is precisely what happens after a short-circuiting operation, and there will be no difficulty with cæcal impaction as long as the colon is unobstructed. A simple short-circuiting operation in the obstructed case will not only be of no service but is distinctly contra-indicated. Either the obstruction must be relieved or the colon removed up to the point of obstruction at the time of anastomosis, or an impacted cæcum will result.

To my mind the most serious complication is that of unusual post-operative adhesions which, by contraction, cause obstructions, varying from slight narrowing to complete cutting off of the bowel. Symptoms from these adhesions are usually not apparent for several months after operation; although I lost one case from acute obstruction in the third week of an apparently smooth convalescence. These adhesions are peculiar in that they are usually in patches and are the result of local peritonitis in widely separated parts of the abdomen. These constant patches of peritonitis are due to direct infection at the time of operation because of a technical error in the arrangement of the steps of the Lane operation, used almost universally by American surgeons. In making the anastomosis, the infected thread, which sews through and through the colon wall, is handled by the surgeon, touches the gauze packs, and renders the whole field unsterile, after which the patient is eviscerated and the split in the mesentery stitched. In spite of the most scrupulous care on the part of the surgeon it is impossible to prevent some infection at this time, and the handling of the whole abdominal contents in moving the small intestine to the upper abdomen is accountable for the wide distribution of the infection. As Lynch has suggested, it is an easier surgical procedure to sew the mesentery

before the anastomosis is done, and it is also safer to make the opening and sewing of the colon the last step in the operation, at which time the field must be considered infected, and the same care exercised to prevent the distribution of infection as is customary in operating in a recognized infected field.

The technique of intestinal anastomosis has been largely influenced by the development of the technique of gastro-enterostomy, where it has reached its highest point of perfection. This technique, however efficient in the comparatively uninfected upper abdomen, cannot be used in anastomosis of the colon or terminal ileum, where the contents are highly infected. The wide application to all parts of the intestinal tract of this simple and effective method of sewing is responsible for the great preponderance of post-operative adhesions which are prone to follow all operations entailing the opening and sewing of the lower bowel.

Experience has shown that late in the convalescence alarming symptoms develop in the cases in which a partial or complete colectomy accompanies the intestinal anastomosis. This occurred in my work until I properly appreciated the importance of the *physiology* of the parts removed, and adopted a very simple routine of supplying fluid to the patient before it became evident that it was necessary. In six consecutive partial colectomies since that time I have not seen any untoward symptoms develop. Lane gives a large quantity of saline solution under the skin while the patient is on the table, and repeats it later if the patient shows signs of needing fluid. Although I followed Lane's rule, my early colectomy cases all became dehydrated, developed rapid pulse, nausea, vomiting, and in most cases acute dilatation of the stomach. Their condition was more alarming from the fourth to the eighth day than immediately following operation — the reason is obvious. About 65 per cent of all the fluid intake of the body is absorbed by the cæcum and ascending colon. The sudden removal of this filter leaves the patient unable to pick up water until the left side of the colon has taken up the work — usually from six to ten days. If the patient during this time be given salt solution under the skin *daily*, the convalescence will lose all its terrors and become that of any major abdominal operation.

The importance of the choice of cases to be operated upon and the choice of operation in each individual case cannot be overestimated. Improper selection of either is sure to be followed by defeat in obtaining the desired symptomatic results, as well as by post-operative complication, which would be attributed to the surgery itself. Ileocolostomy is designed to relieve a stasis in the ileum — the result of an obstruction preventing the free passage of its contents to the cæcum. This has nothing to do with colon stasis, or constipation, and if a simple short circuit be done on a patient with constipation, a secondary colectomy will probably have to be done for impacted cæcum. We should not expect to cure a mechanical difficulty in the large bowel with an operation designed only to relieve a mechanical difficulty in the small bowel. If a patient suffering from toxæmia from the *small bowel only* becomes a surgical case, I believe that the simple Lane short circuit is the operation of choice, and I am sure it can be done with safety, if the simple precautions against adhesions mentioned above are followed. If, as is usually the case, the obstructed ileum is accompanied by a dilated cæcum, which has lost the power to empty itself normally, the "Mayo right-sided colectomy" is, to my mind, the operation of choice. The technique, as developed in the Mayo clinic is free from the criticism of the Lane technique, in that the intestines are not handled after the colon has been opened, and thus the possibility of infection is greatly lessened.

CIRCULAR CONSTRICTION IN THE TREATMENT OF FRACTURES OF THE LONG BONES

By F. W. PARHAM, M.D., F.A.C.S., New Orleans

At the meeting in December, 1912, of the Southern Surgical and Gynecological Association, Mr. Milne, of the London Hospital, showed a device for the fixation of fractures of the long bones. This consisted of a metal band with a screw-thread its whole length, along which a nut was made to move by means of a spanner as shown in Fig. 1, *a*, *b*, *d*, *and e*. The band is thrown about the bone, the one end passed through a loop at the other end, and the band tightened by the spanner until the fragments of bone are held in place, when the nut is fixed and the band cut off.

I was so much struck with this device that after getting back home I began to experiment to see if the apparatus could not be somewhat simplified. My aims were two: first, to find the best and simplest material to place about the bone, and second, to make as simple as possible the device for tightening the constrictor band. The second part of the apparatus was first elaborated on the principle of the écraseur or the wire snare. The constricting material was not so easily settled upon. I first tried silver wire doubled so as to form a loop at one end. The loop end was to be passed about the bone, the free end carried through the loop and a perforated shot slipped over the wire. This being attached to the tractor was easily drawn up and tightened by turning the traction screw and made as snug as desired about the bone. As the wire was tightened, the shot was, of course, driven against the bone immediately over the loop and there mashed against it. This appeared extremely simple and, theoretically, seemed likely to answer all expectations. However, in practice something always went wrong. We afterward twisted the wire, which seemed especially to adapt it to holding

Fig. 1. *a*, *b*, *c*, *d*, *e*, Milne's Instrument.

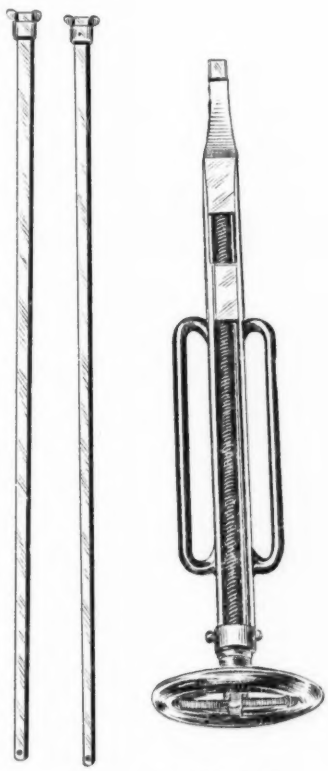


Fig. 2. Putti's Apparatus.

Fig. 3. Putti's instrument showing band tightened and about to be carried over and caught between the two lateral ears.

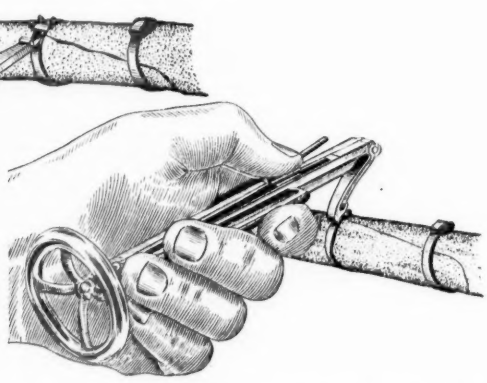


Fig. 4. Putti's instrument showing tightening of band. Upper band tightened and cut.

itself in place about the bone, but it was found that when sufficient force was put upon the wire to tighten it, either the wire broke or cut through the shot, so that the constriction was lost. We experimented with different kinds of wire — copper, aluminum, and bronze — but found none answered the purpose. Dr. Martin suggested a steel band with a slit in one end, expanded so as to make room for the other end to be slipped through. A hole in the other end made it easy to attach it to a pin near the end of the screw rod which was drawn up by turning the wheel at the other end.

After various modifications, in the perfecting of which we were cheerfully assisted by our instrument makers, the apparatus, as finally elaborated and sold to the profession, is represented in Fig. 8.

I showed the apparatus before the American Society of Clinical Surgeons which met in New Orleans in March, 1914, and presented a femoral fracture treated with two bands. Dr. Martin shortly afterward applied two bands to a fracture of the tibia, holding the fragments so firmly in place that they were not displaced when in a delirium the following night the man got out of bed and walked about the ward (Figs. 10 and 11).

Dr. Lund, of Boston, asked me to send him one of the instruments shortly after this meeting and was able to report at the recent meeting,[1] in Washington, of the American Surgical Association, 30 cases thus treated. He applied the bands in Boston last October before the Clinical Congress of Surgeons of North America, taking X-ray pictures of the cases immediately afterward, showing the fractures reduced and the bands in place.

Dr. Matas recently called my attention to an article on a new method of osteosynthesis, by Professor v. Putti, published in *La Clinica Chirugica*.[2] In this article Professor Putti gives a history of metallic ligatures in the treatment of bone fractures and describes an apparatus of his own which he had employed with success. Cuts explain the apparatus fully. It will be observed that there is a striking similarity between this apparatus and the Parham and Martin device.

I did not know of his work until May 1, 1916, when Dr. Matas called my attention to it as above stated. The suggestion of the Parham and Martin apparatus was derived, as mentioned in the beginning of this paper, from Mr. Robert Milne, of London. He subsequently showed his instrument and made

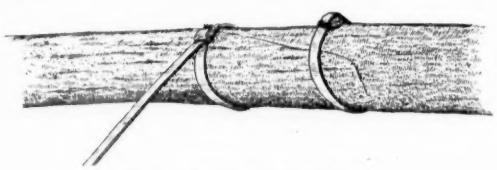


Fig. 5. Putti's bands applied.

[1] May, 1916. (See following article in this issue.)

[2] Clin. Chir., Milano, 1914, xxii, June 30.

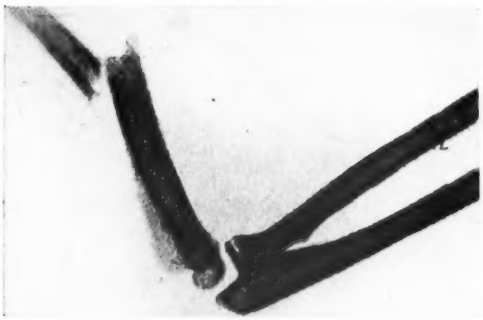


Fig. 6. Fracture of humerus. (Putti.)

some remarks upon its use at Murphy's clinic in Chicago. The remarks and cuts are published in *Murphy's Clinics* for April, 1913, to which I am indebted for the illustrations of the Milne apparatus here given.

The Parham and Martin bands are intended for oblique fractures. If it is desired to apply them for a transverse fracture, a plate or the girder of Mr. Souttar, shown in Fig. 1, *c*, and two bands would have to be employed. This girder is a metal plate about a half inch wide bent along the middle, parallel to its length to a little less then a right angle. A longitudinal slit is made in the fragments while held in apposition and one edge of the plate driven in until the other lies flat on the bare surface. The band, or two bands, are then applied, or the plate may be held in place by two or more screws.

The article of Putti is so interesting that I shall give here an abstract of it, prepared from a translation kindly made for me by Dr. Graffagnino, of New Orleans.

The metallic ligature, one of the oldest methods of uniting bones, should not be confused with the metallic suture, which is limited in its application and should be definitely abandoned. The metallic ligature is based, he thinks, on correct principles and should be considered the method of election for all fractures of the extremities, oblique and overlapping.

Fig. 7. Bands applied with two plates to fracture in Fig. 6 (Putti).

It has been customary to use wire of various composition and size, which is held about the bone by twisting together the ends.

The result depends on two factors:

1. Quality of material.
2. Manner of employing it.

Silver has been most used, but does not answer well because it breaks so easily. Bronze-aluminum is better because of its tenacity and resistance to oxidation, but it is not very malleable. In Putti's opinion that advocated by Lambotte is best. This is a gold or silver plated copper wire.

The objections to wire are:

1. The wire being cylindrical does not adhere well to the bone.
2. Fixation by twisting the ends together results in breaking the wire at the critical moment.

Putti was unable to overcome these objections, so he finally turned to the metallic band, fastening it about the bone somewhat after the manner of a slip-knot. The tightening is done by a band fixer, which is illustrated in the accompanying illustrations, Figs. 2 to 5.

The band is composed of an alloy with a bronze base. It varies in width and thickness according to need. The 2.5 and 6 millimeter width has been most used.

From the cuts it appears that the fixer catches the band which is drawn up gradually by the long screw worked by the wheel at the other end. The required tension being obtained, the handle is carried forward, bending the band through an arc of about 90°, when it is cut off and the instrument removed. To avoid irritation of the tissues the band is carried between the two metallic ears just beyond the bridge of reflection through which the band has been passed (Figs. 2, 3, 4, 5, 6, and 7).

It will be observed that Putti's instrument is more complicated and cumbersome than the Parham and Martin apparatus, requiring as it does a loop for making the slip-knot and

Fig. 8. Parham and Martin instrument and band.

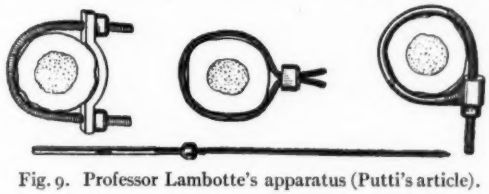


Fig. 9. Professor Lambotte's apparatus (Putti's article).

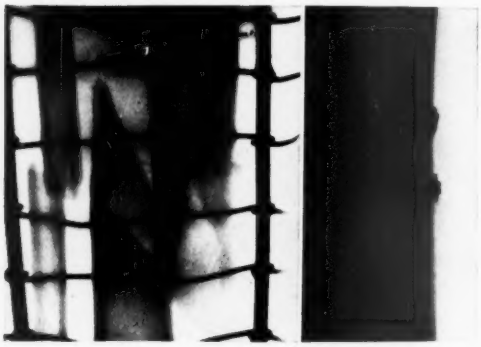


Fig. 10. Fig. 11.

Fig. 10. Dr. Martin's case.
Fig. 11. Same case with two bands.

two lateral ears just beyond to hold the band *in situ*.

In our instrument there is nothing but a slit in the expanded end through which the other end is passed. The tension of the band when tightened is sufficient to hold it in place.

The band is of steel with a sufficient percentage of carbon to give it just the right degree of rigidity. The width varies from 3 to 5 millimeters.

It will be seen from a comparison of the two instruments that ours is decidedly simpler, being a simple band passed through a slit and clamped by simply holding it down flat. To cut it off requires only that it should be held fast by a chisel while the tractor is wiggled to and fro a few times, when the band breaks readily. It is then driven down flat by a few taps of the mallet on the chisel pressed against it. The instrument is so simple that the whole operation may be completed without once touching the wound (Figs. 8, 10, 11, 12, and 13).

Dr. Lund has devised a simple instrument for passing the band and we have used a needle like a large aneurism needle, which answers well. The band itself is easily passed

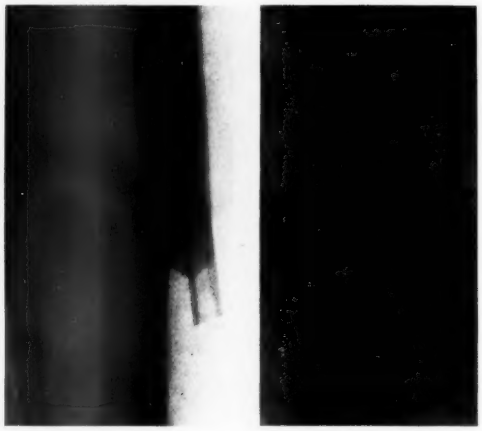


Fig. 12. Fig. 13.

Fig. 12. Parham's case of oblique compound fracture, May 31, 1916.
Fig. 13. Band applied June 3, 1916. The band was subsequently removed owing to some irritations with slight necrosis. Healing has been satisfactory.

without any aid in some cases, but generally speaking it is difficult to do this as the band is not well adapted to moving about a cylindrical bone surrounded by dense fibrous tissues, such as those attached to the linea aspera of the femur or the interosseous membrane of the tibia.

Mechanically, this band method is extremely simple and effective. I have not intended to discuss the question whether, as W. P. Carr, of Washington, asserts, it really violates an essential principle in the treatment of fractures and actually interferes with callus formation. A most elaborate investigation published in the *British Journal of Surgery* has led Mr. Hey Groves to conclude that in dogs and cats it does inhibit the development of external callus under and over the circular band, but the work of Dr. Lund, which has been more extensive than Dr. Martin's and mine, seems to show that practically the objection does not hold.

THE PARHAM AND MARTIN BAND IN OBLIQUE FRACTURES

With Remarks upon Mechanical Appliances Versus Bone Grafts[1]

By F. B. LUND, M.D., F.A.C.S., Boston

As we gain further experience and skill in the operative treatment of fractures, we are more and more able to make an intelligent choice of the cases which should be operated upon early, to operate more skilfully and take better aftercare, thus avoiding the painful necessity of operating late upon the bad results of those fractures which have received the so-called "conservative" treatment.

In fractures of the femur — particularly those cases in which the old Buck's extension treatment entailed for the patient so much discomfort and so long confinement in bed (three to six months), and for the surgeon so much care and constant adjustment of the apparatus — have our results been more satisfactory and the method of obtaining them more easy and comfortable, both for the patient and the surgeon.

In cases of transverse fracture of the femur, especially those where repeated attempts fail to bring the ends into apposition, and in which X-rays show the ends overlapping or perhaps actually separated by a clear space, "interposition of soft tissue," is the operation indicated. We gain by operation, with firm internal fixation: (1) the knowledge that the ends of the femur are in perfect position; (2) the ability to hold them there by fixation in a plaster-of-Paris dressing; (3) the power to bid farewell to the cumbersome, unsatisfactory, and trying extension methods. We can also practically ensure for our patient a perfect anatomical result without shortening.

The long plates with six or eight screws offer very good fixation in femur fractures, but the length of the limb and the power of the muscles are so great in proportion to the strength of the plate that without firm, long-continued external fixation a slight springing of the ends may take place, the screws gradually loosen and pull out, and marked bowing, or actual displacement of the ends, occur, resulting in failure. Of course, experience has by this time brought us to use wood screws and to fit them tightly in the screw-holes; but even with adequate technique fixation by plates and screws is not absolutely satisfactory, and long and careful immobilization is necessary.

Even though in plating our results are better than with the old methods and our deformity less, union is not much more rapid, and in fact some (Martin) have claimed that it takes place more slowly, and I think he is right.

In oblique and comminuted fractures we have a method of fixation which is simple, rapid, mechanically effective, and "gets" union in a comparatively short time. I refer to the steel band devised by Parham and Martin, of New Orleans.

Oblique and spiral (or uncomminuted) fractures are perhaps more frequent than transverse. Transverse fractures are produced when the fracturing force is applied at right angles to the bone, as when a man in an automobile accident is thrown sideways against a telegraph pole. Oblique and spiral fractures occur when the force is applied nearly in the longitudinal axis of the bone, as in falls from heights striking upon the feet, especially if the body be twisted so as to produce rotation. Sheerness of the application of force tends against transverse and for spiral fracture. If we wish to break a stick transversely we pull it sharply across the knee. If we wish to splinter it, we stand it on end and hit it with a mallet, or twist it, holding one end in each hand. It seems possible that a majority of fractures of the shafts of the long bones are more or less spiral or oblique; at least, we use the bands nowadays full as often if not oftener than the plates. An obliquely-fractured bone may be compared to a broken fishing rod; the rod always breaks obliquely with a splintered fracture, and the effective way to mend it is to wind it with waxed thread, thus bringing the fractured surfaces in apposition and holding

[1]Read before the American Surgical Association, Washington, May 9-11, 1916.

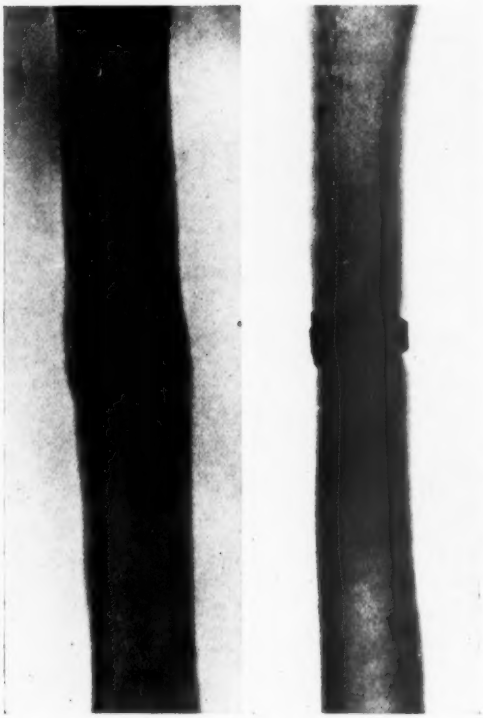


Fig. 1. An oblique fracture of the femur, banded two years ago, in a child, aged four years. *A* (left), anterior view, showing band embedded in the femur and entirely covered by new periosteal bone; *B*, lateral view, showing that here the bone has not entirely embedded the band.

them firmly. The same principle is applied to bone by the Parham band. The bone if outside the body might be wound with copper wire, as a fishrod is with thread, and the result would be excellent. But this would take much time and cause much trauma in operating through a deep incision in the muscles of the thigh. A single wire passed once around the bone would not give firm enough apposition, and would be likely to cut its way quickly into the cortex, so as to be too rapidly loosened.

The band of Parham and Martin is wide enough so that one or at most two of them passed around an oblique fracture give effective support, and they can by means of the band-placer be carried quickly around the bone and fixed as quickly as a wire can be twisted. The rough oblique-fractured surfaces are firmly held together, and the fragments evidently much more firmly supported than are the transverse fractures by a bone plate. The strain on the plate is transverse and sometimes breaks it. The strain on the band is longitudinal; it never is broken after it is once in place. The firm apposition of the rough surfaces of bone prevents slipping, twisting, and springing. Union takes place quite rapidly, and motion may be allowed several weeks earlier than with the bone plate. The band is wide enough so that it does not cut in and thus become loosened. It is simpler of application than the plates and screws as it requires no drilling of the bone, accurate fitting of screws, or careful use of screwdrivers and drills. The one advantage in the plate and screws is that one does not always have to clear the soft tissues off clear around the bone, but can grasp the ends with heavy forceps, and drill and put the plate in without clearing the soft tissues off the posterior surface of the bone. This is an advantage in the femur because the linea aspera is difficult to clear, and it is there, if anywhere, that we get hæmorrhage, while in the tibia we must avoid the interosseous membrane and the occasional injury of the posterior tibial, which may take place if we carry instruments carelessly around behind the bone. This slight disadvantage is not to be weighed for an instant in the oblique cases, however, against the other advantages of the bands. A very clever instrument has been devised by Dr. Duff, of Boston, which may be passed around the bone while hugging its posterior surface, and with the minimum of trauma and separation of soft parts, which in my hands has greatly facilitated the passing of the bands. They may thus be quickly and simply applied. In spiral fractures with comminution the band holds the separated piece firmly in its position between the main fragments of the shaft; or if one band (as is rarely the case) does not accomplish this effectively, two will certainly do so. For these cases before I knew about the bands I formerly used a plate and wires.

In our hospital we have a good many oblique fractures of the femur in children, and three years ago I began to use the band on those.

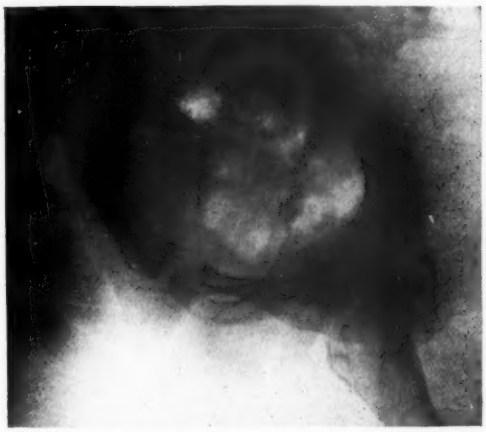


Fig. 2, *A*. Ankylosis of the hip in an eight-year-old boy.

Fig. 2, *B* (left). Oblique fracture of femur on the side of ankylosis; *C*, same fracture treated by the band. (This fracture would have been extremely difficult to treat by extension, owing to the angle at which the bone was ankylosed. The boy was walking on the leg in seven weeks.)

After banding and plaster-of-Paris fixation the patients have been surprisingly comfortable, and the great advantage has been that no adjustment of apparatus has been required. After four weeks the plaster can be taken off, and after lying in bed a week the little patients get up on crutches and very soon are running about. The results in these cases have usually been perfect. When we first began to use the bands we were warned by various surgical wiseacres that in these children, as the bones grew, the bands would cut in and girdle the bone and that fracture would result; or that the band would cut off the nourishment from the distal portion of the bone and prevent its growth, comparison being made to girdling a growing tree by a wire tight enough to cut off the flow of sap and kill it. But the blood and lymph which nourish a bone do not flow straight up between the periosteum and bone as does the sap between the bark and wood of a tree, from bottom to the top, or the root to the branches. The periosteum from which the surface of the bone is regenerated is nourished by blood-vessels from all sides, which are not cut off by the band, and the marrow is nourished by the branches of the nutrient artery, which, as it is protected by bony walls, is not compressed or cut off by the band. None of my children who have had their femurs encircled by bands has suffered subsequent fracture, and I am fortunate enough in one case to be able to present an X-ray photograph (Fig. 1) of a femur in a child, aged four years, about which a band was placed two years ago. The picture shows the femur slightly widened at this point, and the band included in the shaft of the bone which has grown over it. In time it must happen that the band is shut up or enclosed in the bone, and how it can cause irritation when firmly fixed in rigid tissue is difficult to see.

The question may fairly be asked why we have not undertaken the inlay bone graft method in these fractures in order to do away with foreign bodies and employ nothing but normal bone tissue for fixation.

The answer is that we have felt that in fractured femurs the muscle wound is necessarily so deep that it would be a difficult job to saw out the graft, and that the use of the band is so simple and easy as compared with the other that in fresh fractures one would

Fig. 3, *A* (left). Oblique fracture of lower end of femur in a woman, aged sixty-three years. The difficulty of adequate treatment by extension in this case is evident. *B*, same case treated by band. There was rapid and uneventful recovery and good function.

Fig. 4, *A* (left). Spiral fracture of the tibia in an adult. *B*, same after application of band.

hardly be justified in employing the latter method. The inlay bone graft, also, is obviously much better adapted to transverse than oblique fractures.

Fresh cases of fracture of the tibia, if transverse, can usually be brought into apposition without operation; in fact, they are usually the result of direct violence applied in a transverse direction and the fibula keeps them in place. In the much commoner spiral fracture the line of the fracture does not favor the inlay graft, while the band holds the surfaces in perfect apposition and must give a firmer support than would the inlay graft. An inlay graft would obviously be much easier to saw out in the subcutaneous surface of the tibia than in the femur.

The non-operative treatment in spiral fracture of the tibia never adequately gets the ends in apposition, and there is always at least an inch of shortening. The results of the band treatment, it seems to me, leave little to be desired, as the bone is restored practically to its normal contour.

When plates are applied to the subcutaneous surface of the tibia, they usually have to be removed, as they are placed so superficially beneath the skin that they ulcerate through by pressure. However, bands on the tibia hardly ever have to be removed; practically never if the operation is aseptic.

The bands are applied as follows: a longitudinal incision through the skin, fascia lata, and muscle exposes the fracture, which is cleared of periosteum, reduced by extension and manipulation with the heavy Lane forceps in the usual way. Then the periosteum is cleaned from the bone around the central point of the line of fracture, the Duff instrument passed around the bone and the band caught by the hook in the end and drawn around. The end is then threaded through the slot, the hole caught in the pin, and the screw turned until the band tightly encircles the bone. The band is then bent sharply back by depressing the handle of the instrument and the instrument freed and removed. The band is then cut off close to the slot with wire cutters and the end hammered down. The fascia lata is closed with a continuous catgut suture and the skin with silkworm-gut without drainage. Smoothly-applied sterile gauze and wadding and bandage; plaster-of-

Fig. 5, *A*. Oblique comminuted fracture of upper end of femur.

Fig. 5, *B*. Same after application of band.

Paris spica to thigh. The bandage should extend from the toes to above the knee in case of fractured tibia.

Six weeks in plaster is the time required for an adult thigh and four weeks for a tibia. Stitches are removed in ten days through a window cut in the plaster. On removal of the plaster of Paris, union is usually complete. In femur cases the patient is kept in bed one week with the plaster off and then gets up on crutches. There is usually some temporary œdema on removal of the plaster of Paris.

Sepsis ought never to occur and may of course be insured against by adequate technique. If it does occur the wound must be opened, washed out, and drained, but it may not be necessary to remove the band for four to six weeks, by which time bony union is complete. Infection may result in bad adhesion of the muscles to the bone and in stiffness of the knee. It is a very serious matter and a reproach to the surgeon or hospital where it occurs. With a competent and a well-trained staff we can count on avoiding it, but unfortunately we cannot always be certain where constant changes in assistants are made and an occasional incompetent slips by, as in many of our large hospitals.

Since January 1, 1914, I have used the bands in 14 cases and the Lane plates in 7, showing that in 66 per cent of our operative femurs the bands can be used. Since January, 1911, I have plated 30 femurs. I have used the bands 9 times in oblique fractures of the tibia and have not used the plates at all for the tibia since we had the bands. I had previously used the plates for 13 tibias. I

have never used the bands for the forearm bones, fractures of which, 16 in number, I have subjected to open operation since 1911: 11 were plated, 1 wired, 1 sutured (olecranon), 2 open reductions, and 1 bone graft.

The figures which follow have been chosen to illustrate cases suitable for treatment by the bands, cases in which it would be difficult to get good and quick results by so-called conservative treatment. Note especially Fig. 3, *A* and *B*, and Fig. 4, *A* and *B*, in both of which a good and quick result was attained.

As a result of this experience and the observation of the cases of my colleagues, I believe that the Parham and Martin band is of very valuable assistance in the treatment of many difficult fractures, and I wish to express my debt to the distinguished inventors, and to say that it is not the only one of their contributions to surgery which has been of great value.

NAILS AND SCREWS IN JOINT SURFACES[1]

By ARTHUR T. MANN, M.D., F.A.C.S., Minneapolis
Associate Professor of Surgery, University of Minnesota Medical School

THIS series of experiments was undertaken after nailing a fractured and misplaced external condyle in the elbow of a boy of seven, through the joint surface, in order to determine the behavior of nails and screws so placed, and the joint changes in response to their presence.

This boy was referred to me six weeks after the fracture with the fragment still out of place, though the usual methods had been faithfully used to replace it. I was unable to replace it by any of the ordinary methods and determined upon an open operation. After opening the joint we found the fragment rotated nearly one hundred and eighty degrees about a slight attachment to the external lateral ligament of the elbow and standing straight out from the joint. Little or no callus had formed and it was fairly easy to reduce it, but it would not stay in place. It could not be made to stay in place either with the elbow at acute angle flexion, at right angles, or with the arm straight. The head of the radius forced it out of place. We decided to nail it through the joint surface. This was easily done. Firm adhesions developed to the tissues about the joint which, later, had to be broken up forcibly under ether. This loosened the fragment somewhat from its bed, but the final result was a good serviceable arm with moderate limitation at the extremes of motion.

The method described was suggested to me by an admirable article on joint fractures by Sherman and Tait in the course of which they detailed some experiments with Lane's plates, bone pegs, screws and staples, and in the course of which they stated that, after a painstaking search, they could find no case in the literature in which nails and screws had been used through the joint surfaces.

I think my series of experiments bring out some further points of interest.

In the whole series no joint became infected and no specimen was lost. In most of them rubber gloves were used; a few were done with the bare hands to see if the technique would stand this amount of exposure. No dressings were used after painting the suture line with tincture of iodine and the dogs were allowed to run about without fixation of the joints. Most of them favored the leg operated on for a time, but as a rule, they soon lost their limp and all of them were running about actively without a limp at the time the specimens were recovered.

Dog No. 690. *Right knee:* Two nails were driven into the inner condyle and countersunk less than the thickness of the cartilage. Moderate trauma was added to the cartilage about them. Four months 6 days after operation (Fig. 1): The nails are entirely covered with a thin layer of tissue apparently of the same color as the rest of the cartilage. The cartilage is nearly smooth but not quite in the area close about the nails. The semilunars and the joint cartilages are otherwise apparently smooth and normal, opposite the nails as elsewhere. There is no staining at the heads of the crucial ligaments.

Dog No. 690. *Left knee:* A five-eighths inch silver plated screw was countersunk into the inner

[1] Read before the Western Surgical Association, Des Moines, December 17, 1915.

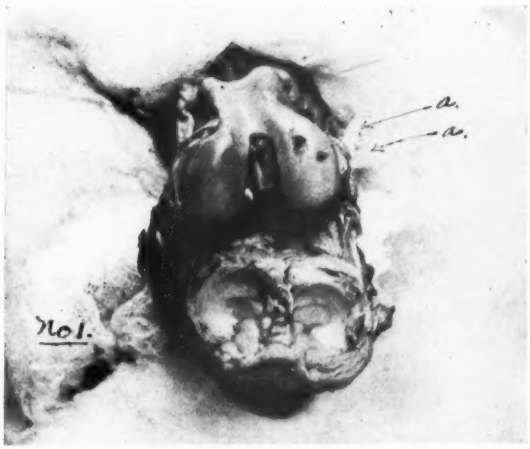


Fig. 1. Experiment 690, right knee, 4 months 6 days after operation. Two nails countersunk less than the thickness of the cartilage. *a*. Nails entirely covered with connective-tissue.

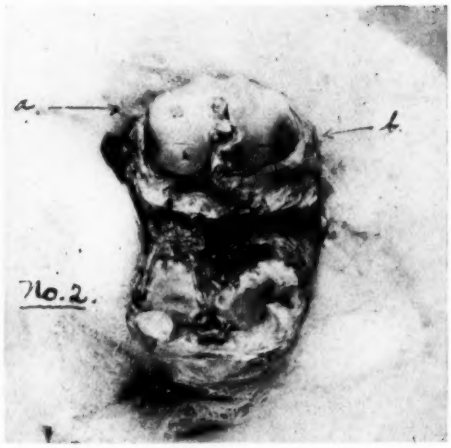


Fig. 2. Experiment 690, left knee, 3 months less 2 days after operation. Five-eighths inch silver-plated screw sunk well below cartilage surface. *a*. Screw entirely covered. Condyle apparently slightly built up about screw.

condyle of the femur well below the thickness of the cartilage. Three months less 2 days after operation (Fig. 2): A slight amount of blood was in the joint. The screw is entirely covered and the condyle apparently *slightly built up about the screw area*. The covering is not yet quite smooth and does not show quite as clear a translucent gray as the rest of the cartilage.

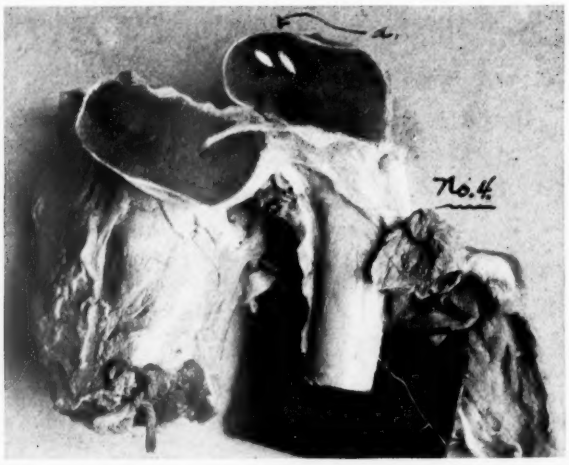
The cartilage on the outer posterior quarter of the other condyle shows some thinning, is a pale pink, and the surface is not quite so smooth as the normal cartilage, possibly from overuse due to a faulty position of holding the leg during the stages of convalescence. This was the only case in which changes suggestive of osteo-arthritis were present. The cartilage of the tibial head suggests a very slight similar change while the semilunar seems normal. This was an old, poorly nourished dog, and we came to the conclusion that this was probably present at the time of the experiment and not the result of the experiment.

The surfaces opposite the screw seem normal. Though some blood was left in this joint the roots of the crucial ligaments are not as stained as in most of the other specimens, practically none at the femoral ends.

Dog No. 697. *Right knee:* Two nails were driven into the internal condyle of the right femur and countersunk well below the depth of the cartilage. Three months 24 days after operation (Figs. 3 and 4): The nails are completely covered and the tissue is almost level with the joint cartilage, slightly pitted but nearly smooth. The semilunar cartilage and the bearing surface of the tibia opposite the nails is perfectly smooth and normal. *The cut surface* shows no apparent overbuilding of bone or cartilage above the normal level. Both nail heads are covered across with bone which is lined with tissue about the same thinness as the joint cartilage.

Dog No. 697. *Left knee:* One-half inch silver plated screw was countersunk, not quite the thickness of the cartilage, into the condyle of the left femur. A second larger drill was used to take care of the flare of the screw head. Two months 20 days after operation (Figs. 5 and 6): There has evidently been *a slight upbuilding of the condyle* about the screw. The screw head is entirely covered by a thin plate of tissue, at a lower level than the joint surface and with the lower edge growing over the edge of the screw with almost the joint level. The opposing joint surface on tibial and semilunar cartilages is smooth and normal. *The cut surface* shows bone beginning to grow inward over the top of the screw and is covered in turn by a thin cartilaginous or connective tissue.

Dog No. 726. *Left knee:* A silver plated screw was countersunk into the inner condyle of the left femur so that one edge was flush with the surface and the other edge buried one and one-half millimeters below the surface. Six months less 2 days after operation (Figs. 7 and 8): *The surface of the condyle has built up* so that the free edge is buried. The edges of the tissue have grown over the screw head, burying all but one-fourth of its area, and has grown way across in the groove of the screw. The joint surface is glossy and smooth at all other places in the joint. There is no roughness or inflammation of the head of the tibia or semilunar cartilage opposite. The joint is apparently normal in every other way, except possibly the slight staining at the head of the inner crucial ligament. *The cut surface*



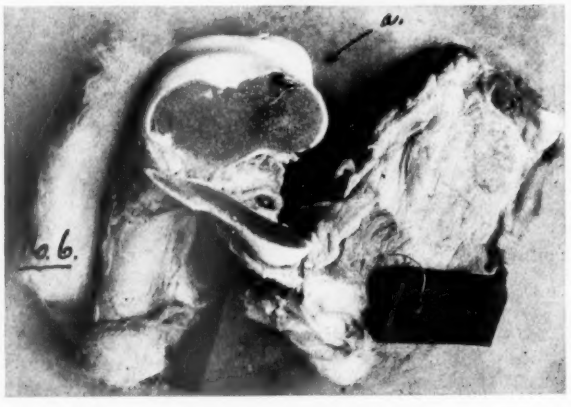


Fig. 3. Experiment 697, right knee, 3 months 24 days after operation. Two nails below depth of cartilage. *a*. Nails completely covered.

Fig. 4. Experiment 697, right knee. Cut section, 3 months 24 days after operation. No apparent building up of condyle. *a*. Nails covered with bone and connective-tissue.

Fig. 5. Experiment 697, left knee, 2 months 20 days One-half inch silver-plated screw sunk not quite the thickness of the cartilage. *a*. Screw entirely covered by a thin plate of connective-tissue.

Fig. 6. Experiment 697, left knee. Cut section, 2 months 20 days after operation. Evidently a slight up-building of the condyle about area of screw.

shows bone as well as connective tissue in the tissue growing over the edge of the screw head, and the advancing tissue is not quite as thick as the normal cartilage of the joint.

Dog No. 726. *Right knee:* A steel screw was inserted as before so that its upper edge projected over 0.5 millimeter, the lower edge being buried about 1 millimeter, the inner edge flush with the cartilage, and the outer edge about 0.75 millimeter below the free surface. Five months after operation (Fig. 9): *The surface of the condyle is built up* enough to more than make up for the projection of the screw. The edge of the screw is covered to a very slight extent, three-fourths of its circumference, although the inner quarter is still free and uncovered. The joint is otherwise smooth and apparently normal, with no stretching of the tibial cartilage or the semilunar over which it swung and got its bearing, except that a little gloss is lost on the surface. There is a slight staining at the roots of the crucial ligaments at the femoral end. (The condyle was not sawed open.)

Dog No. 576. *Right knee:* Two nails were driven into the same condyle of right femur, one anterior to the other. The anterior one, a small head nail, was driven in flush with the cartilage surface. The

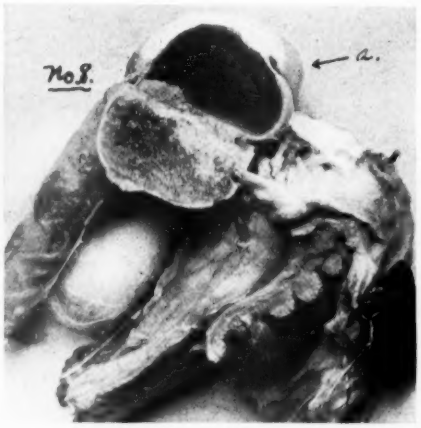


Fig. 7. Experiment 726, left knee, 6 months less 2 days after operation. Silver-plated screw with one edge flush with cartilage. *a*. Screw buried all but one-fourth of its area. Surface of condyle is built up so that the free edge of the screw is buried.

Fig. 8. Experiment 726, left knee. Cut surface, 6 months less 2 days after operation. *a*. Condyle built up about area of screw, and screw three-fourths covered with bone and connective-tissue.

Fig. 9. Experiment 726, right knee, 5 months after operation. Steel screw with one edge projecting over ½ millimeter. *a*. Edge of screw slightly covered three-fourths of its circumference. The condyle has built up enough to more than make up for the projection of the screw.

Fig. 10. Experiment 576, right knee, 6 weeks 1 day after operation. Two nails, one flush with cartilage, one projecting about 2 millimeters. Undoubted growth in thickness of the condyle about the nails. *a*, *a*. Nails partly covered with connective-tissue. *b*. Groove cut by nail in head of tibia partly refilled and covered smoothly with cartilage.

Fig. 11. Experiment 576, right knee. Cut section, 6 weeks 1 day after operation. Undoubted growth in thickness of the bony condyle with the cartilage no thicker than normal. *a*, *a*. Nails partly covered; nail no longer projecting.

second was broken off below the head and the jagged edge was left projecting about 2 millimeters above the joint surface. The joint was freely swung back and forth to cut a groove into the head of the tibia and into the semilunar cartilage.

Six weeks plus 1 day (Figs. 10 and 11): Undoubted *growth in thickness* over the major portion of the condyle about the region of the nails, to an elevation represented by the projection of the broken nail. Neither nail surface is entirely covered. The

new tissue is nearly smooth and apparently of the same character as the normal cartilage, but in reality shows a connective-tissue structure. The groove, which had been cut deeply through the semilunar cartilage, the cartilage of the tibia head, and into the bone, has smoothed up and partially refilled in the six weeks. The surface is covered smoothly with cartilage, looking like the normal cartilage of the joint surface. The joint cartilages are otherwise smooth and normal. There is no staining at the heads of the crucial ligaments. *The cut surface*: The new increase in tissue seems entirely due to new bone. The new cartilage which covers this elevated area is no thicker than the thin cartilage of the joint surface.

CONCLUSIONS

1. Nails and screws are tolerated in joint surfaces in the human as well as in the experimental cases; and with surprisingly little reaction.

2. They have remained firmly imbedded in every specimen recovered.

3. In every case where the nails and screws projected above the joint surface, there was a distinct upbuilding of the condyle as Nature's reply to a rigid metal body projecting into the joint.

4. It is exceedingly interesting to find that the increase in joint level seems always due to the growth of bone and not to the increase in the thickness of the cartilage.

5. In each case where tissue grew across over the head of a nail or screw, or across in the groove of the screw, the new tissue showed a reversion to the connective-tissue type.

6. Even when the nails and screws have remained more or less uncovered, the dogs have run about normally after a short convalescence.

7. In each case the scratch or groove on the opposing surfaces was filled in as the projection of the nail or screw lessened by the upbuilding of the condyle. The defect was apparently entirely filled in all but one specimen and this was closing in nicely at the end of six weeks.

8. As a point in technique it seems better to swing a hinge-joint freely at time of operation to scratch the groove made necessary by a badly placed nail or screw, and thus save the time and pain which would be required in scratching the groove little by little later.

NEW MECHANICALLY AND SURGICALLY CORRECT METHOD OF BONE GRAFTING

Comparison of Various Methods of Open Treatment of Fractures

By PAUL B. MAGNUSON, M.D., Chicago

LANE PLATE

SINCE Mr. Lane stimulated world-wide interest in the open treatment of fractures with the introduction and use of the steel plate screwed onto the outside of the shaft of long bones, there have appeared many and devious ways of holding fractured fragments of long bones in apposition by many forms of mechanical appliances.

From a surgical standpoint, the Lane plate is deficient in the following ways:

1. In most individuals, steel acts as an irritant both to soft tissues and to bone with which it comes in contact, favoring infection by producing a collection of serum around the plate, and lowering the resistance of the tissues immediately in contact with it, if not actually killing them.

2. The necessary length of the plate, in order to secure proper leverage, necessitates the loosening of the muscles from their attachment to the bone for a considerable distance on either side of the fracture, thereby producing unnecessary trauma and favoring infection.

3. The screws used in Lane-plate operations are of the wood screw type, and it is necessary to use at least four in each plate to prevent the fragments from angulating. The pressure of these screws on the bone gradually

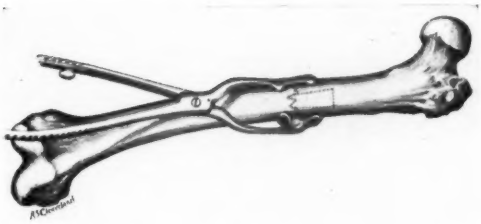


Fig. 1. Magnuson lateral bone clamp in position holding fragments in apposition. Outline of intended graft showing width of medullary cavity at site of fracture, one-eighth inch wider at opposite end.

produces necrosis of the bone-cells immediately surrounding them, allowing the plate and screws to loosen in a comparatively short time. This allows the plate to move and further irritate the tissues both bony and soft, which further produces a favorable field for infection.

These are, in brief, the main objections to the use of the Lane plate from a surgical standpoint.

From a mechanical standpoint, the only bearing surface which the Lane plate affords in holding the bone in line is that which is provided by the small wood screws driven through the plate and into the bone. This is a very weak form of mechanical union, and when taken in conjunction with the fact that pressure of the screws produces necrosis of the bone immediately in contact with them, we have double reason for not wishing to trust entirely to the support of a contrivance of this kind.

In spite of these objections, there are some cases in which it is impossible to use anything but the Lane plate in repairing a fracture, and one should always be at hand to suit the occasion no matter what plan is made before the operation.

THE BONE PLATE[1]

The bone plate of Brougham and Ecke has the advantage of being non-irritating and easy of application, but has the disadvantage of the Lane plate in that the muscles must be disturbed from their connection with the bone over a relatively large area. It is

[1] Brougham and Ecke. A preliminary report on the treatment of fractures by fixation with animal bone plates and bone screws. Surg., Gynec. & Obst., 1914, xviii, 637.

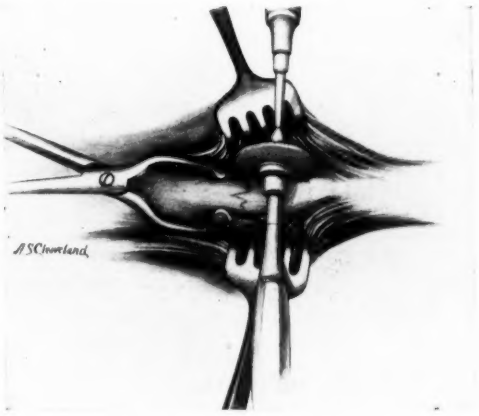


Fig. 2. Author's circular saw cutting sides of bone graft. End of graft is cut with thin bladed chisel or smaller saw with single handle. Note distance between jaws of clamp allowing free room to work.

claimed that this plate is absorbable. In the author's experimental work, however, with both dead bone and ivory, it has been shown that neither dead bone nor ivory are absorbed except where they are closely surrounded by bone. The screws driven through these bone plates and into the bone cortex will eventually be absorbed only in such part as lies within the bone, leaving the plates without any attachment except an incapsulating fibrous tissue which forms around them. The mechanical application of the plate to the outside of the bone throws an undue strain on a substance which is brittle and which is not braced on all sides, and, consequently, subject to easy breakage.

Brougham and Ecke have used the screw principle introduced by the author, of tapping a thread in the bone and bone plate and using bone screws, which undoubtedly hold much better than steel screws. The plate, however, is weak at the points where the screws are driven through it. The objections, then, to this form of apparatus are, from a surgical standpoint, the loosening of the muscles and production of extra traumatism in the application; from a mechanical standpoint, its weakness at the points where the screws penetrate the plate.

These plates, however, are improvements over the Lane plate, and should constitute a

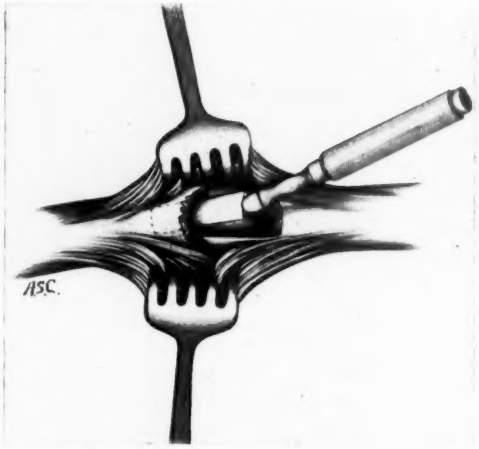


Fig. 3. Clamp removed and fragments slightly angulated to allow insertion of graft into medullary cavity of opposite fragment. The socket wrench, which is used in driving the screw, is also used as an instrument to drive the graft in. Dotted line shows the final position of the graft inside medullary cavity.

part of the equipment of the surgeon doing any amount of open treatment of fractures.

IVORY SCREWS[1]

In 1908 the author introduced the method of retaining fragments of bone in correct apposition by the use of ivory or bone screws. The channel for these screws was first cut out by drilling a hole smaller than the screw to be used and tapping a thread within the bone with an ordinary mechanic's tap. This method has proved highly satisfactory in the treatment of oblique fractures of all kinds, since it does away with the necessity of dissecting loose, to any extent, the muscles attached to the fractured bone. The field of operation can be made small and traumatism to the bone and soft tissues reduced to a minimum. The screw holds the rough ends of the fragment in close apposition not only in one plane, but in all planes. It fits snugly into the hole made for it, but not so snugly that it produces necrosis of the cells surrounding the screw. The retention apparatus is small as compared with the size of the bone,

[1] Magnuson. Lengthening shortened bones of leg, Univ. Penn. M. Bull., 1908, May; Ivory plates and screws in the open treatment of fractures, J. Am. M. Ass., 1913, Dec. 13; Lengthening shortened bones of the leg by operation, Surg., Gynec. & Obst., 1913, xvii, 63.

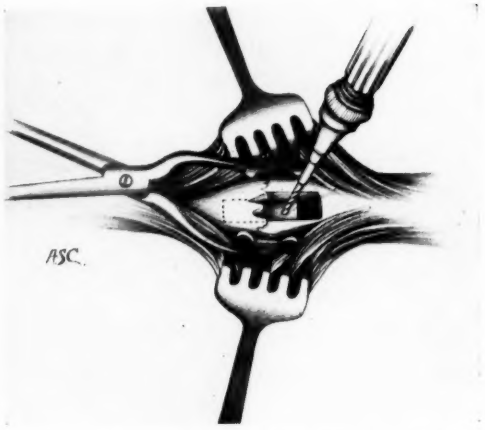


Fig. 4. Fragments brought back into line. Graft in place. Drilling hole through graft and opposite side of cortex preparatory to cutting thread for ivory screw.

but on account of its mechanical construction which follows the lines of a machine screw rather than a wood screw, it has a long bearing surface. This screw is cut off flush with the cortex on both sides allowing nothing to project into the soft tissues to irritate them. Neither the ivory nor bone screw will irritate the tissues with which it comes in contact. This operation is simple and is easily and quickly performed. If the oblique surfaces of the fracture are long, a screw at each end of the obliquity will hold against any pull of any group of muscles in the body, not allowing angulation or displacement of the fragments, and allowing early motion of the joints above and below the fracture.

One ivory screw has been used in the treatment of a slightly oblique fracture of the femur on a number of occasions, with perfect results. An article to follow reporting a series of cases of open treatment of fractures with the use of ivory plates and screws, will contain the X-ray pictures and photographs of these cases.

From both a mechanical and a surgical standpoint, the screw used in this way is an ideal method of treating oblique fractures.

IVORY PLATES

In transverse fractures it is impossible to use screws alone. It was therefore necessary

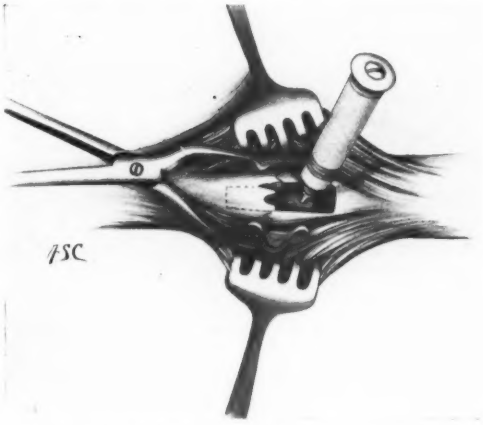


Fig. 5. Mechanic's tap introduced by the author in 1908 used for cutting threads in bone the same size as screw to be used.

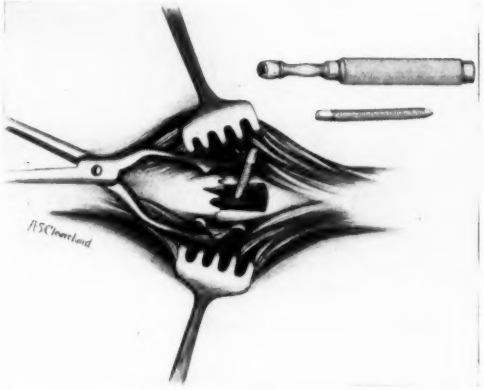


Fig. 6. Socket wrench used as screw driver. Square headed ivory screw. Screw being inserted into graft to hold it in slot out of which it was taken.

to devise some method which would meet the following requirements:

1. Minimum traumatism in application.
2. The substance must be non-irritating to the bone and soft tissue.
3. It must remain *in situ* without loosening.
4. It must be strong enough to hold against strains in any direction, and the constant pull of any group of muscles without allowing angulation or shortening.

In order to meet the first requirement, the apparatus must necessarily be small. It had been proved that ivory was non-irritating to bone and soft tissues. It had also been proved that ivory did not loosen, which was also true of dead bone. The fourth requirement — strength — gave ivory the preference over dead bone, and it was therefore used instead of the latter.

The method used consisted in the cutting of a slot or, as mechanics term it, a keyway into the bone by parallel circular saws, the slot being exactly the width and length of the plate to be used and extending across the fracture in the long axis of the bone, the length of the largest plate being one and three-fourths inches long and three-sixteenths inch thick by one inch wide. A keyway and key is the strongest form of mechanical union known so far as a shaft is concerned, the key being braced on all sides but one by the material into which it is driven. As long as this key remains in the keyway and is fixed by pegs driven through the key and shaft at an angle to the key holding it down into the slot, it is impossible for any motion to take place between the fragments of the shaft. This operation eliminates the necessity of loosening the muscles from the shaft for more than an inch on each side of the fracture, reducing the amount of traumatism to a minimum. The retention apparatus is very small and is, as previously stated, non-irritating. The plate is driven snugly into the slot cut through the proximal side of the cortex only, its lower edge being driven tightly against the medullary side of the opposite cortex. As in the case of the screws, the application is snug, but not tight enough to produce necrosis of the bone-cells immediately in contact with it. The ivory, being braced on all sides by the bone cortex, has sufficient strength to resist all strain which is exerted on the fragments by the muscles, and in the very nature of its application will not allow the slightest angulation.

This operation has proved very satisfactory not only in the hands of the author, but, at this writing, in the hands of many surgeons. Special instruments are needed to perform it, but this is true of every operation as it is in other mechanical lines of work.

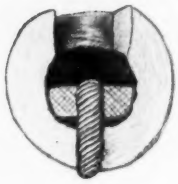


Fig. 7. Cross section of graft through plane of screw showing slot out of which graft was taken. Position occupied by graft in medullary cavity and screw through graft and cortex of opposite side holding graft firmly in place.

THE INTRAMEDULLARY BONE GRAFT

The intramedullary autogenous bone graft as used and advocated by Murphy was one of the first forms of autogenous graft used in the open treatment of fractures. This necessitates cutting down on the tibia and removing the crest, reaming out the medullary cavity of the fragments above and below the fracture. This destroys at least part of the endosteum, delays union to some extent, and produces considerable hæmorrhage. The graft is then inserted into the medullary cavity of one fragment to almost its full length, the fragments being slightly angulated out of the wound and the graft being worked into the medullary cavity of the fragment not already occupied by it. This, of necessity, makes a weak and loose mechanical union. It will hold the fractured pieces from moving past each other, but will not prevent angulation to a certain extent. The bone graft strikes the inside of the cortex at three points; namely, at each end and at the fracture. This gives a lever of the first class, permitting any jolt or jar to break the graft, or the pull of the muscles to gradually bend it, unless the external dressing is firmly fixed, which is almost impossible in cases of fracture of the femur just below the trochanters.

This operation necessitates opening up not only the bone which has been fractured, but making a wound in the lower leg, necessitating two operations instead of one.

THE BONE INLAY

The bone inlay as advocated by Albee follows the same principles as the ivory plate, the advantage of it over the ivory plate being

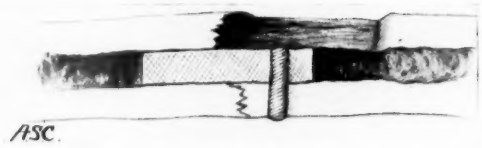


Fig. 8. Longitudinal section through bone graft and screw showing position of graft in medullary cavity. Slot left by excision of graft, and screw holding graft in place.

that it possesses bone regenerating power. The objections to it are that it necessitates cutting down on the tibia to secure the graft, producing extra traumatism of this bone, and necessitates extensive cutting operations on each side of the seat of the fracture, loosening up considerable distances of muscle from the bone and cutting a considerable trough of bone out on both sides of the fracture.

As first described by Albee, this bone graft was tied in with kangaroo tendon run through small drill holes at the edge of the slot, and through the edge of the graft. Sutures have never been a strong form of mechanical union in bone, either in the shape of wire or kangaroo tendon or the like, and it should be borne in mind that a severe strain by muscle pull is put on every fracture-retention apparatus, whether it be external or internal. Albee has recognized this fact in his recent work by introducing the use of an autogenous bone screw put in in the way described by the author and already referred to. The use of the autogenous screw is unnecessary, takes a considerable amount of special equipment, lengthens the time of operation, and has no advantage over the ivory or dead bone screw, since it is the bone graft which is depended upon to regenerate bone at the seat of fracture. This procedure, then, is superfluous. It is impossible without producing tremendous traumatism and hæmorrhage to cut out a key of bone and fit it into a full length slot as described by Albee in the case of a femur or humerus, and these are the bones most frequently necessary to treat by open operation.

It is also practically impossible without producing tremendous traumatism to cut a long slot on one side of the fracture and a short one on the other, moving the long piece of bone down across the fracture, and using

the short piece for the purpose of making bone screws as described by Albee, without freeing the muscles from the bone for a considerable distance on each side of the fracture, producing a great deal of hæmorrhage both from the muscle and bone, and lengthening the time of operation and shock thereof to an unwonted extent. This operation can be done very nicely on the tibia where the bone lies immediately under the skin and where there is no muscle to contend with. Consequently, favorable reports of this sort of graft in the tibia mean comparatively little.

It was to correct the defects mechanically and surgically in the bone-grafting operation that the procedure next to be described was devised. The requirements were: (1) To secure an autogenous graft as small as possible to assure firm retention of the fragments; (2) to eliminate the necessity of traumatizing other fields than that of the fractured bone; (3) to shorten the time of operation; and (4) to place the graft in the bone in such a way that it would prohibit motion in any direction and hold against any pull exerted on it by the muscles attached to the shaft.

This was done by cutting a short graft from the fractured end of the most convenient fragment either proximal or distal. This graft was cut in the shape of an extremely long-sided truncated cone. The end of the graft which formed part of the fractured surface is exactly the width of the medullary cavity, and the end farthest from the fracture not over an eighth of an inch wider than the medullary cavity, the graft being from one and one-half to two inches long and covered by periosteum. The sides of the graft being cut out with the circular motor-driven saw, the end of the graft is freed with a thin bladed chisel. The opposite fragment is then angulated slightly out of the wound, and the graft driven in to the end of the medullary cavity to half its length. On account of its wedge shape it fits snugly. The fragment is then brought back into line with its fellow, and the protruding end of the graft is driven down into the slot out of which it came. This being the wider end allows for the thickness of the saw blade on each side and yet allows the graft to come closely in contact with the walls of the cortex on each side and sink down into the medullary cavity. The result now is that one end of the graft is firmly driven into the end of the medullary cavity of one fragment, the other end being driven into the lower end of the slot out of which it came. There is no way of angulating these fragments except by one end of the graft slipping out of the slot or keyway. This was provided against by drilling through the graft and the opposite cortex, tapping a thread in the bone and putting through an ivory screw which holds the key firmly down in the keyway. The screw is then cut off flush with the graft, leaving nothing protruding beyond the cortex on one side or the graft on the other, and leaving a one-inch trough above the graft to be filled in with new bone.

This operation has been extremely satisfactory in the hands of the author and a few other surgeons who have seen fit to use it. It does away with the necessity of cutting into any other bone to procure the graft and meets all the mechanical requirements of a strong union. There is not as much loosening of the muscles as there would be in a Lane-plate operation but somewhat more than in the ivory-plate operation. In cases of ununited fracture the bone graft is preferable to any dead bone substance.

The technique described shortens the time of operation, lessens the shock, and does away with a large amount of the hæmorrhage which occurs when the graft is taken from the tibia. Therefore, we believe, it meets all the mechanical and surgical requirements of the internal splint, and that it will be found to be much more satisfactory than the methods heretofore advocated.

A CONTRIBUTION TO THE ETIOLOGICAL STUDY OF OVARITIS[1]

By CARL HENRY DAVIS, M.D., CHICAGO
From the Memorial Institute for Infectious Diseases and the Department of Obstetrics and Gynecology, Rush Medical College

ELABORATE studies have been recorded giving the histological changes which occur in acute and chronic ovaritis. The bacteriology of acute ovaritis has been studied extensively, but heretofore little has been accomplished in the cultural studies of the chronic inflammations associated with sclerosis and cystic degeneration. The newer bacteriological methods as emphasized especially by Dr. Rosenow have made this study possible. That some of the acute infections of the ovary may be of hæmatogenous origin and not a direct extension from the lower genital tract was suggested by Lawson Tait many years ago and is supported by many recent clinical observations. Rosenow has demonstrated that bacteria from foci of infection and the involved tissues in various diseases from which the streptococcus is recovered, such as appendicitis, ulcer of the stomach, cholecystitis, erythema nodosum and herpes zoster, tend to infect electively the corresponding organs in animals, when injected intravenously, and recently he has shown that some of the streptococci which we recovered in chronic inflammation of the ovary showed elective affinity for these structures in animals.

Using a technique which has been described in other papers, Dr. Rosenow and I have cultured 65 ovaries. In three of the patients the condition was rather acute, and in these the streptococcus viridans was recovered twice and the gonococcus once, The other patients had chronic pelvic disorders. In ten cases the cultures remained sterile after a week's incubation. In the remaining 52 cases in which the ovaries showed fibrous and cystic degeneration, streptococci were isolated 30 times, the number of colonies ranging from one or relatively few, usually in the depths of the ascites-dextrose agar, to countless numbers. They were present in pure culture in 8, and associated in the others with the Welch bacillus, a few staphylococci or colon bacilli. Welch bacilli were found in small numbers in 21, diphtheroid bacilli in 10, a few colonies of staphylococcus albus in 9, the gonococcus in 2, the colon bacillus in 3, and an anaerobic streptothrix in 1.

The associated abdominal conditions were carefully recorded in 56 of the histories. Fibromyoma of the uterus was found in 18 patients, and the ovaries from 15 patients gave positive cultures—the streptococcus viridans being isolated from 11, and the Welch bacillus from 8. Salpingitis was reported eleven times, and the ovarian cultures were positive from 9, streptococcus viridans in 8, Welch bacillus in 3, and gonococcus in 2. Chronic appendicitis occurred 11 times, and the streptococcus was recovered from 8 of the ovaries. Eight patients had a chronic cholecystitis, and 6 of the ovaries cultured contained the streptococcus viridans.

Only a few of the women with chronic ovaritis gave a history of a preceding acute pelvic infection. In a number it seemed evident that the pelvic symptoms were the result of contracting a cold during the menstrual period or followed definite attacks of tonsillitis. In others the pelvic symptoms were subsequent to some one of the acute infectious diseases of childhood. While many of the women were married and more exposed to the conditions producing ascending infections, a number were undoubtedly virgins and in at least one patient, in which the ovarian cultures showed the streptococcus, the possibility of an ascending infection can be definitely eliminated.

MICROSCOPIC ANATOMY OF THE HUMAN TISSUES

The microscopic changes were such as have been described in the extensive studies on fibrocystic degeneration of the ovary and do not call for detailed description. With the help of W. L. Brown, 16 additional ovaries have been studied since the joint report with Dr. Rosenow, making a total of 39 ovaries which have been carefully examined. In a

[1] Read before The Chicago Gynecological Society, April 21, 1916. (See discussion p. 635.)

number these were remnants of follicles, which were largely replaced by connective tissue and surrounded by round-cell infiltration. The stroma in all showed marked fibrosis and frequently small islets of the interstitial cells. The blood-vessel walls were thickened. The walls of the small cysts were infiltrated with numerous round cells, while the walls of the larger ones were made up of old connective tissue. Nests of round-cell infiltration were found in many, chiefly surrounding the blood-vessels, and in the walls of the graafian follicles. In a number aggregations of leucocytes were found within and around small blood-vessels, especially in those in which the portion cultured showed a relatively large number of streptococci.

To demonstrate the bacteria in the tissues was extremely difficult, but in sections from eleven ovaries including the eight previously reported, where the cultures showed a large number of the streptococci, Gram-Weigert and methylene blue stains showed diplococci. They were found usually in the areas of infiltration and in at least one case in the wall of a corpus luteum.

Discussion. Lawson Tait in his monograph on *Diseases of the Ovaries* says: "So far as I know, acute ovaritis is the result of four diseases only:

"1. Injury;

"2. Gonorrhœal infection;

"3. Septic poisoning in the parturient condition;

"4. Exanthematic fevers and acute rheumatism."

Thus it is evident that Tait recognized non-ascending acute infections of the ovary, dependent upon the exanthematic fevers and acute rheumatism, even though he had no knowledge of the bacteriology of these conditions. He says: "In 1870 and 1871, and still more in 1874 my attention was drawn to the occurrence of acute pelvic peritonitis in women after attacks of scarlet fever and small-pox, these attacks leaving indications which showed clearly that the mischief began in the ovaries. Accident enabled me to trace the subsequent history of two such cases, and I found that in both the menstruation became greatly diminished in amount and that it was accompanied by severe dysmenorrhœal symptoms, and that in one of the cases it entirely disappeared. From these cases I began to suspect that the attacks were primarily due to inflammations of the uterine appendages, and that this had some kind of relation to the zymotic disease which preceded it." Later he writes: "I have only once had an opportunity of dissecting a case where I had recognized chronic ovaritis in life, and then it certainly was the result of acute rheumatism. It occurred in the case of a girl seventeen years old, who had suffered from eight or nine attacks of rheumatic fever. In two of them she was under my care as a dispensary patient; and after the recession of the particular infection an attack of pelvic pain came on, which was increased by pressure, and the attack was accompanied by an irregular menstrual flow. The whole passed off in a few days after the application of a blister, but ever afterward her menstruation was irregular, profuse, and painful, and she suffered from the symptoms which I shall describe immediately. I regarded the attack as one of mild acute or subacute ovaritis, followed by a chronic stage. She died subsequently of embolism of a cerebral artery, and I found her ovaries large, soft, covered with lymph, and dotted with enlarged follicles, and the peritoneum was thickened around them. The left ovary was adherent to the rectum, and it had nearly the whole of the fimbriæ of the corresponding tube glued to it."

It has long been recognized that mumps are apt to cause orchitis in men and ovaritis in women. But Joel, in 1886, called attention to the occurrence of orchitis in boys and ovaritis in girls following tonsillitis. For generations women have recognized that to take cold during a menstrual period was apt to result in a suppression of the menses with subsequent dysmenorrhœa and often pelvic pain. Our textbooks all recognize this fact but I have never seen a satisfactory explanation.

The recent writers of books on gynecology all recognize the possibility of non-ascending infections of the ovary, but they apparently believe that most of the infections are ascending. Dr. Webster writes (p. 365) on the

etiology of acute ovaritis: "Various infective conditions, e.g., especially infection following abortion or labors, gonorrhœa, pneumonia, mumps, the acute exanthemata, tuberculosis, actinomycosis, etc." And (p. 366) "Chronic inflammations of the ovary may be the sequel of an acute attack, such as has been described, or it may develop slowly, with no definite onset . . . . Active congestion, displacements, and twistings are favoring conditions. It is frequently secondary to infectious processes in the uterus and tubes. It is very frequently associated with fibromyomata of the uterus and large ovarian tumors of the opposite side. Of all the causes gonorrhœa is one of the commonest. It may be secondary to appendicitis." Findley says: "Chronic ovaritis may be the terminal stage of an acute infection of the ovary. Any condition causing prolonged congestion of the ovary will result in chronic ovaritis, such for example, as sexual excesses, menstrual congestion, subinvolution, malpositions of the uterus, habitual constipation, incompetency of the cardiovascular system, pelvic and abdominal tumors, and the disorders of the organs of digestion." Findley made a careful study of 180 cases operated on for cystic ovaries by Dr. Webster and himself. He found that: "The usual infectious diseases of childhood were experienced in 65 per cent af the 180 cases; and there was a history of puerperal, post-abortive, or gonorrhœal infection in 63 per cent." He believes from this study and a review of the literature that: "Cystic degeneration of the ovaries is almost invariably the result of chronic ovaritis." This is the consensus of opinion of Virchow, Gebhard, Abel, Kolb, Ruge, Pfannenstiel, Amann, Martin, and Frankel (Findley).

Wilder in a recent paper presents strong evidence that acute streptococcic ovaritis may follow the streptococcic sore throats. He quotes three typical cases reported by Leyden, Kunzel, and Schwers, and adds a fourth personal observation. In these four cases there can be little doubt but that the acute infection of the ovary was blood-borne and in each case secondary to the infection in the throat. Yet with the normal genital tract it is almost impossible to prove from the study of the cases that the infection could not have been ascending. But this clinical evidence is proved by the case in our series in which chronic salpingo-ovaritis had developed in an eighteen-year-old girl in whom there was no passage between the vagina and uterus. It is further strengthened by a case in which there was a congenital stenosis of the uterus with a double cavity. The cultivation of streptococcus viridans from the ovarian tissue in these cases, the demonstration of the organisms in sections of these ovaries, the experimental production of ovaritis in animals, and the finding of the organisms in their ovaries explain clearly how a patient may contract chronic ovaritis without a preceding infection of the lower genital tract. While allowance must be made for the possibility of direct extension of infection from some other infected organ, such as the appendix, the finding of the colon bacillus in only 3 cases is good evidence that chronic ovaritis can be but extremely rarely, if ever, due to organisms which have passed through the normal bowel wall.

While the experimental work explains the importance of the streptococcus in ovarian degeneration, the significance of the Welch bacillus in one-third of our cases is not so clear. Since this organism is found so frequently in the cultures of tissues of carnivorous animals, it has been thought that it is, as the rule, a rather harmless invader. But Williams states that the bacillus aerogenes capsulatus is occasionally concerned in puerperal infection, and several cases have been reported from his service at the Johns Hopkins Hospital. In our series a pure culture of the Welch bacillus was obtained from the ovary of a woman who had suffered with puerperal sepsis, but while the ovarian trouble dates from the sepsis it may not follow that this organism was responsible for either the degeneration or the preceding sepsis.

From our cultural studies of 65 ovaries it would appear that the streptococcus viridans is the most common organism associated with the chronic degeneration of the ovaries, being found in approximately 50 per cent of the cases. The Welch bacillus was found

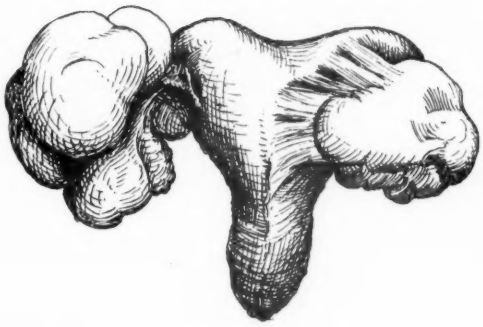


Fig. 1. Drawing of specimen, Case 960.

in 33 per cent but is probably of little importance. Other organisms are apparently found rarely in the usual chronic degenerative changes of the ovary. While the gonococcus is undoubtedly a common cause of acute infections of the ovary it is not found in the more chronic conditions, and our results suggest that some of the chronic pelvic conditions which were formerly credited to the gonococcus may have resulted from non-ascending infections with the streptococcus viridans.

The fact that ovaritis is so much more common than is orchitis is of considerable significance. Wilder in his review collected 56 cases of primary peritonitis, probably all of the streptococcic type, of which 44 or nearly 80 per cent were in females. He believes that in most of these that the primary infection was in the ovary and the peritonitis secondary. It has been suggested that the corpus luteum is often the point of inoculation. Certainly the fact that women are so prone to infection of the ovary at the time of menstruation is a strong argument in favor of this suggestion. That the tube may become infected from the ovary or the ovary from the tube is generally accepted and it is also probable that both are infected simultaneously from the blood-stream in some cases of bacteræmia.

The following two cases which were reported in the joint paper with Dr. Rosenow are of so much importance in the discussion of this subject that they must be included in our case histories.

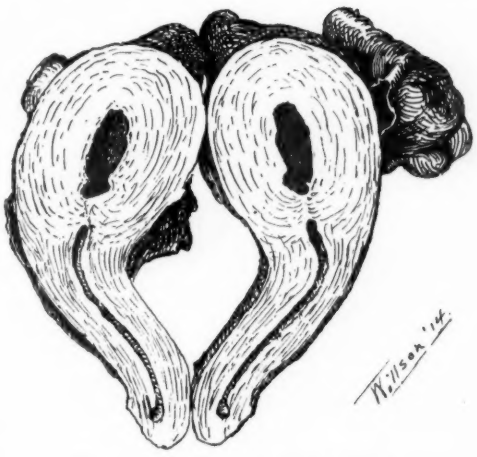


Fig. 2. Drawing of specimen, Case 960.

Case 960. A girl of 18 years entered the Presbyterian Hospital complaining of a dull, heavy, aching pain in the right inguinal region, which recurred each month during the past year, lasts three days and then disappears. She has never menstruated. At the operation Dr. Webster found an imperforate vagina one inch long, the uterus was retroverted, the cervix lay posterior to the vaginal wall and was only attached to the corpus by means of a fibrous band; there was considerable thickening of both tubes with closure of the right, fibrous and cystic degeneration of both ovaries, especially the left, and adhesions about the rectum and appendix. He did a modified panhysterectomy and appendectomy.

A drawing of this specimen is seen in Figs. 1 and 2. Twelve colonies of streptococcus viridans were grown from a portion of the left ovary, and a diplococcus was demonstrated in the sections.

Case 373. A single woman, age 30, entered the Presbyterian Hospital on the service of Dr. Billings, July 20, 1914, complaining of multiple enlarged swollen, tender, painful joints and muscles, particularly the jaw, elbows, hands, and feet, with marked limitation of motion and fixation. The arthritis began three years before, some weeks after a severe attack of tonsillitis. There had been recurring exacerbations and remissions of the symptoms, but, on the whole, they had steadily progressed. She had lost 30 pounds in weight during the past year and a half, and in the past year had developed a severe dysmenorrhœa. Cramps and nausea had lasted throughout the period and often for eight or ten days following. Except for frequent attacks of tonsillitis and a chronic rhinitis, the patient had been in fairly good health until three years before, when she had the attack of tonsillitis with an abscess of the tonsil. The tonsils were removed

nine weeks after the arthritis began and she improved greatly. She had measles and whooping cough in childhood. During the past year she had been curetted twice for the dysmenorrhœa without relief. The patient had a good appetite and slept well. The bowels were regular, there was no urinary disturbance, no leucorrhœa at the time of examination, no cough, no dyspnœa, no night sweats, no œdema of the feet, no cardiac or gastric disturbance, no jaundice, no diarrhœa, no chills or fever. The examination was negative except for the condition of the joints, the finding of a small remnant of the left tonsil, and some bad teeth. X-ray of her hands showed that there was complete ankylosis of some of the fingers, with marked destruction of the cartilage in the balance of the joints. The remnant of the tonsil was removed and the condition of her teeth rectified. The patient left the hospital and returned again in January, 1915. The symptoms of the arthritis had greatly improved, but she complained of excessive menstrual flow for which she was curetted by Dr. Webster but without relief.

On March 23, 1915, Dr. Webster removed the left ovary, ligated the uterine arteries, removed the appendix and a small fibroid from the back of the uterus. Cultures of the ovary were made by Dr. B. O. Raulston and the streptococcus viridans obtained in large numbers. Dr. Rosenow injected sub-cultures into three female dogs and four female rabbits in doses ranging from 4 to 95 cubic centimeters of the broth culture suspended in salt solution. All but one rabbit recovered. The animals were chloroformed on the second and third days after injection. All of the animals injected showed lesions of one or both ovaries. Five showed in addition distinct arthritis; one myositis; one cholecystitis; and two hæmorrhages and œdema of the thymus. Three showed lesions in the uterus, and one hæmorrhage in the fallopian tubes. Filtrates of this broth-culture, on the other hand, injected into two rabbits in equivalent and repeated doses failed entirely to produce lesions in the ovary or otherwise.

Following the operation in March, the patient's general symptoms were much better, but the menorrhagia soon returned and on October 5, 1915, Dr. J. C. Webster removed the uterus and remaining ovary. Cultures of this ovary were made by Drs. F. Gaarde and G. Coleman and the same organism was again isolated. This injected into rabbits produced arthritis, but unfortunately their ovaries were not examined for lesions.

When seen on March 25, 1916, the patient stated that she had gained twenty pounds in weight and that she feels much better in every way. She still has joint pains but less severe.

The following histories are chosen from the cases cultured because of the large numbers of organisms found in the cultures and the variety of associated conditions:

No. 90389, Mrs. D., age 24, entered the Presbyterian Hospital, November, 1915, complaining of weakness, a constant feeling of tiredness, headaches, backache, pain in the lower right quadrant of the abdomen, leucorrhœa, and constipation.

During the past year she had felt tired and weak all of the time, especially on arising in the morning. During the past four months she had been unable to work. She has had severe headaches during the past four months, frontal in character, dull aching in type, and present nearly all of the time. They are especially severe in the morning and are gradually growing worse. During the same period she has had a dragging backache. For over a year she has had some pain in the right lower quadrant of the abdomen. Four months ago it was very severe but of late it has been causing less trouble. She says that there is a feeling of soreness which comes on whenever she is tired and is always worse during the menstrual period. During the past four years she has had a marked leucorrhœa. Two years ago it was most severe but is better now. During the past three years she has had marked constipation. The patient says that she has had no sickness other than the diseases of childhood.

She was married 5 years ago but has been separated from her husband for 2 years. She had one pregnancy 3 months after marriage and aborted.

The writer dictated the following findings at the operation: Numerous adhesions between the uterus and the rectum holding the uterus in retroversion. The left ovary is about the size of a small English walnut and is buried in a film of adhesions. The left tube is somewhat thickened. The right ovary and tube are buried in adhesions and fastened to the brim of the pelvis. The ovary is moderately enlarged and markedly cystic. The appendix is 4 inches long, slightly thickened, but free from adhesions.

Operation. Freeing of pelvic adhesions. Right salpingo-oophorectomy. Webster round ligament operation. Covering of the raw surfaces in the pelvis. Appendectomy. Cultures of the right ovary showed many colonies of streptococci. Mrs. D. reports March 26, 1916, that she is free from pain, has no headaches or backaches, no constipation. She is at work in an office and while she still tires easily feels perfectly well.

No. 90236, Mrs. R. C., age 49, married, ten pregnancies, no miscarriages or abortions.

The patient complains that during the past year she has had considerable pain in her back, intermittent in character, present during the day but not at night. The aching is worse when she is on her feet, is relieved by massage and by lying down. It has steadily been growing worse. The menstrual flow has steadily increased in amount during the past 4 or 5 years but has not increased in duration. The abdomen has been increasing in size during the past 4 years until now it has the appearance of a 5 or 6 months' pregnancy. There has been some loss in weight. During the last

3 years she has had a severe leucorrhœa. Her past history is negative. Her family history is negative. Habits are negative.

Dr. Webster dictated the following findings at the operation: The uterus is enlarged by tumor mass 8 inches in diameter. Both ovaries are cystic. There is a hydrosalpinx condition of both tubes. There is a simple cyst of the left ovary 2 inches in diameter. Gall-bladder is free and normal. Right kidney is scarcely movable. Left kidney is scarcely movable. Stomach is normal. No nodules or enlarged glands are found in the upper abdomen.

Operation. Supravaginal panhysterectomy. The tumor was found to be an interstitial fibroid of the uterus which had undergone a myxomatous degeneration. The sections showed no evidence of malignancy. Cultures of the ovaries showed many colonies of streptococci.

CASE 57248, Miss S., age 34, entered the Presbyterian Hospital, June, 1910, complaining of constant backache, constant tenderness in the lower abdomen, leucorrhœa, and general weakness, having been in bed most of the time during the past three years. Bowels are regular. Menstruation is of the regular 28-day type, preceded by soreness in the breast for ten days, slight dysmenorrhœa. Has cold chilly sensation most of the time. Has no urinary disturbances. No history of sickness other than the diseases of childhood.

Operation June 22, 1910. Dr. Webster dictated the following findings: Uterus is retroposed, 3 inches deep and dilates with difficulty. Prolapsed, inflamed, degenerated ovaries. Marked adhesions in the pelvis. The appendix is thickened.

Operation. Dilation and curettage; removal of the left tube and ovary; ignisection of the right ovary; removal of the right tube; Webster round ligament operation; appendectomy. The patient had a normal temperature when she entered the hospital but following the operation her temperature went to 104.4° and remained 100 or over most of the time during the following week. Her pulse varied from 72 to 100. She was discharged in good condition July 12, 1910.

Miss S. entered the hospital again June 14, 1914, complaining of pain in the right lower quandrant of the abdomen, nervousness, and general weakness. She stated that the pain is worse during the menstrual period. She has not been very much better since her operation four years ago.

Operation June 15, 1915, Dr. Webster dictated the following findings: There are adhesions of the omentum along the anterior abdominal wall. The right ovary is enlarged, cystic, and fastened with adhesions. The uterus is adherent to the rectum and bladder. The gall-bladder is normal.

Operation. Hysterectomy and right oophorectomy. Her temperature went to 100.8° the second day after the operation and varied between 99 and 100° during the first ten days after the operation.

November 1, 1915, Miss S. reports that she is free from pelvic and abdominal pain. Physically she is perfectly well, but states that she suffers from attacks of melancholia and that she often has severe headaches in the top of her head. She feels particularly bad in the morning but as the day passes she gradually loses her depressed feeling, provided she is with cheerful company, and usually feels good in the evening. She does not suffer from hot flushes and never has had them.

She states that as a girl she was subject to tonsilitis but that the tonsils have not bothered her for many years. The pelvic trouble started with a severe cold contracted during the menstrual period

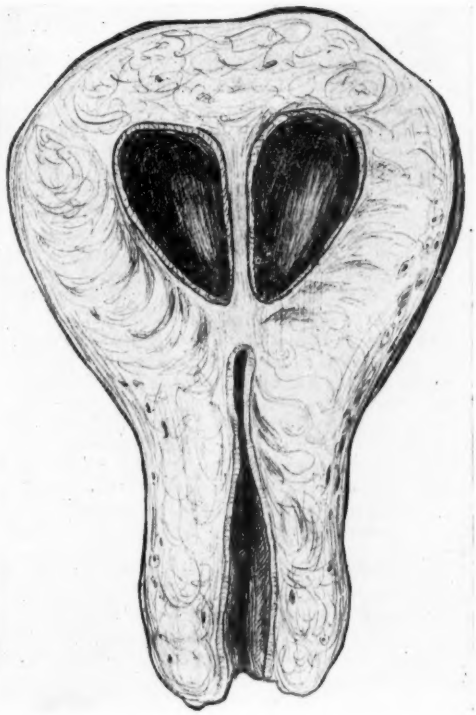


Fig. 3. Somewhat schematic diagram. Case 85742. Mrs. M., aged 19. Since her fourteenth year she has had subjective symptoms of menstruation every 28 days. Had a laparotomy when fifteen. Both tubes and one ovary removed. Had abdominal drainage for four days. During past year she has had a little spotting with pelvic cramps on two occasions, but has never menstruated.

Operation by Dr. Webster revealed dense pelvic adhesions, with loops of bowel attached to the uterus and remnant of the left ovary. Section of the uterus revealed the congenital malformation as shown in the above diagram. She was operated during an attack of so-called menstrual pain, and fresh blood was found in both cavities of the uterus. The endometrium was very thin and showed no evidence of inflammatory changes.

and gradually became worse. She was a chronic invalid for about twelve years.

Miss J. W., age 24, entered the Hospital May 1915, complaining of swellings on each side of the lower abdomen, pain in both lower quandrants of the abdomen, tenderness of the right breast. The patient states that she was perfectly well until about fourteen months ago when she noticed a marked increase in the pain during the menstrual periods; about the same time there appeared a swelling in the left side of the lower abdomen which was tender to the touch and to the pressure of her clothing. A little later a smaller "lump" appeared in a corresponding position on the right side. These swellings have persisted and are still tender to the touch.

The pain is bilateral, but more marked on the right side. It is usually of a dull aching type but occasionally she has attacks of sharp sticking pain. These occur at intervals of four to six days. These attacks are very brief, lasting but a minute or two and they do not radiate. About six months ago her symptoms were so marked that she was confined to her bed for three weeks. Recently she has been much worse again. The right breast has been tender and painful for seven weeks but has not been red or swollen.

Her past history is negative except for measles and whooping cough as a small child and some kind of a fever at the age of nine. Menstruation began at 13 years, regular 28-day type of 3 days' duration until one year ago when she began to flow for two days skipping a day with return for two days. The pain is increased during the periods.

Dr. Webster dictated the following: Gall-bladder normal, kidneys each have a 28-inch range, stomach normal, appendix 7 inches long and fastened with adhesions, uterus enlarged by a tumor mass (fibromyoma) 4 inches in diameter, right tube thickened in the middle part, right ovary shows chronic cystic degeneration but is not much enlarged, left ovary has the same condition.

Operation. Appendectomy; supravaginal panhysterectomy. The patient's temperature went to 101° a few hours after the operation but never went over 101.8° and returned to normal after four days.

SUMMARY AND GENERAL CONCLUSIONS

From a cultural study of 62 ovaries showing the changes found in fibrocystic degeneration and three in which the process was more acute, the findings of the streptococcus viridans in 50 per cent of the cultures suggests that the streptococcus viridans is the most common organism associated with chronic ovaritis. Since the cultures from ten ovaries remained sterile, it would appear that chronic degeneration may result without the presence of bacteria or that the bacteria are gradually killed and the ovary rendered sterile. The findings of the gonococcus in only one acute and one chronic ovary would seem to indicate that this organism may not be responsible for as much of the chronic ovarian disease as was formerly supposed. Although the Welch bacillus was found in small numbers in 33 per cent of the cases yet in the absence of any definite animal experiments it may be considered a more or less harmless invader, still it must be remembered that this organism has been the cause of puerperal sepsis. The staphylococcus albus and the diphtheroid bacillus are regarded as accidental or harmless invaders since intravenous injections of each do not produce lesions in animals.

It has long been recognized that the chronic ovarian degeneration may follow acute infections of the ovary, and this study shows that bacteria must also be regarded as the etiological factor in chronic ovaritis though it has developed without a definite history of an acute infection. The various conditions which cause passive congestion in the pelvis are to be considered as predisposing and not as etiological factors.

The not uncommon history of pelvic trouble following anginal attacks during the menstrual period; the occurrence of pelvic infection following immediately after tonsillitis; the discovery of chronic tubo-ovarian inflammation in a young woman with a congenital stenosis of the cervix and the uterus, with an imperforated vagina, and the isolation of the streptococcus viridans from her left ovary; together with the experimental production of ovaritis in animals seems conclusive proof that hæmatogenous infection of the ovaries occurs and that it may be responsible for much of the chronic ovaritis in which there is not a definite history of gonorrhœa or puerperal sepsis.

The find of bacteria, especially the streptococcus viridans, in the greater portion of the ovaries cultured, offers a logical explanation for the not infrequent recurrence of cystic swellings after resection of the ovary. It also suggests that the ignisection or drainage through a single opening with Paquelin's cautery as practiced by Dr. Webster may be the method of choice since

the heat may kill the bacteria. This study also shows a probable reason why transplanted ovaries degenerate.

A study of the tissues together with a careful review of the histories gives no new or definite means for choosing between a conservative and a radical operative procedure. Since some ovaries are sterile and many others contain only a few organisms, the writer believes that this study favors conservation of the ovaries whenever the operative findings will permit. In this series it was usual to find rather large numbers of streptococci in the ovaries of patients who came to a second operation. With a young woman it is better that she come to a second operation than to lose both ovaries the first time even if there is an equal chance that conserved tissue may degenerate.

The findings of bacteria in fifteen (eleven of which showed streptococcus viridans) of the eighteen degenerated ovaries associated with fibroids of the uterus suggests strongly that bacteria are likewise responsible for the chronic ovaritis so commonly associated with fibromyomata.

Since there appears to be very frequently some rather definite connection between the more common foci of chronic infection and ovaritis, it is evident that in treating a patient with ovarian trouble that any such foci should be located and removed. It would seem logical to believe that by the early detection and elimination of these primary infections it might be possible to lessen the occurrence of ovaritis.

I wish to acknowledge my indebtedness to Dr. J. Clarence Webster for his suggestions and the privilege of reporting his cases, and to Dr. E. C. Rosenow for his co-operation in this study.

REFERENCES

Tait, R. L. Diseases of the Ovaries, 1883, p. 97.
Webster, J. C. Textbook of Diseases of Women, 1907, p. 365.
Findley, P. Diseases of Women, 1913, p. 485.
Pfannenstiel. Veit's Handbuch der Gynækologie, vol. iv, 63.
Joal. De l'orchite et l'ovarite amygdaliennes. Arch. gén. de méd., 1886, xvii, 513, 678.
Rosenow, E. C. The newer bacteriology of various infections as determined by special methods. J. Am. M. Ass., 1914, lxiii, 903.
Rosenow, E. C. Elective localization of streptococci. J. Am. M. Ass., 1915, lxv, 1687.
Wilder, R. Acute infections in the pelvis of anginal origin. J. Am. M. Ass., 1916, lxvi, 569.
Rosenow E. C., and Davis, C. H. The bacteriology and experimental production of ovaritis. J. Am. M. Ass., 1916, lxvi, 1175.

THE LEUCOCYTES IN PREGNANCY, LABOR, AND THE PUERPERIUM[1]

By JOSEPH L. BAER, S.M., M.D., F.A.C.S., Chicago

After Nasse had called attention to the existence of a true leucocytosis of pregnancy, numerous workers began checking his results, at first with widely varying outcome, but finally with sufficient unanimity to warrant the statement that there is a leucocytosis of late pregnancy, especially in primiparæ.

The physiological leucocytosis of labor and the puerperium is generally accepted without debate, but in clinical practice the question constantly arises, Is the leucocytosis in the given case physiological or pathological? To supply a working answer to this question, and to establish a standard of comparison for the leucocytosis and differential analysis of pregnancy, labor, and the puerperium, the following study was undertaken at the suggestion of Dr. L. E. Frankenthal, utilizing the material afforded by the Michael Reese Maternity.

The literature abounds with investigations of this kind, and each worker has laid stress on the errors of his predecessor. For example, it is pointed out that counts should start on the pregnant woman, and be carried through on the *same* woman in labor and the puerperium; that comparisons on different women at different periods introduce an avoidable error; that the figure of interest is the in-

[1] Read before the Chicago Gynecological Society, April 21, 1916. (See discussion p. 634.)

crease in the leucocyte count over the normal for that woman, not the actual count itself; that the figures are complicated by the introduction of abnormal cases into the series; that the influence of digestion was ignored; etc.

Among the earliest views is that found in Virchow's *Cellular Pathology*. He states that there is a monthly increase in the leucocytes in pregnancy, which is proportional to an increase in the lymphatics of the uterus, and an increase in the lymph-nodes of the inguinal and lumbar regions.

Madame Mochnatcheff did a novel piece of research in that she made comparisons between blood obtained from the portio vaginalis and the finger, and found that there is a leucocytosis in pregnancy; that blood from the portio contains fewer leucocytes than from the finger in pregnancy, and that the reverse is true in labor.

Payr stated that there is an adenoid character to the whole endometrium, and hence, in labor, the leucocytes are squeezed into the circulation, thus raising the count.

Rieder examined 31 pregnant women, from fourteen to sixteen hours after eating, and found a range of leucocytes from 10,200 to 16,500, with an average of 13,000. In 50 per cent in multiparæ (18 cases), there was an increase; among 13 primiparæ all but one showed an increase, and during digestion in 6 cases there was a decrease.

Hofbauer constructed curves from 20 cases. The curve starts just above the normal, goes up during and past labor, dropping down soon after labor, and reaches a level ten to twelve hours post partum, which it maintains until the second to the third day of the puerperium, when there is a secondary rise associated with the incoming of the milk. He considered that the leucocytosis of pregnancy was due to the painless, rhythmical contractions; that the first curve in labor was due to the work of the uterus, and the second curve to the activity of the breasts.

Wild, examining 30 cases, found an increase in the leucocytes in labor, and explains the same by means of a comparison between the uterine surface and a wound surface. He states that the increase which continues into the puerperium is due to the resorption of the uterine material.

Hibbard and White present the following conclusions: (1) Leucocytosis exists in three-fourths of all cases, more often in primiparæ, in labor. (2) In the puerperium the curve drops first rapidly, then slowly to normal, rising a little on the seventh day. (3) Leucocytosis is greater in young women and less with each labor. (4) Prolonged labor causes an increase. (5) Breast infections produce a rapid increase. (6) Leucocytosis of labor is an increase essentially in the polymorphonuclear neutrophiles.

Biégoune thinks there is an increase in the last of pregnancy which involves only the ripe forms of the leucocytes; the young forms are decreased. The first day post-partum there is a marked increase in all forms. In the puerperium the polymorphonuclear neutrophiles show a relative and absolute decrease. The eosinophiles are increased at the beginning of pregnancy, decreased post-partum, and then increased steadily after the second day.

Nannicini found that there is no increase in multiparæ. The count stays within the physiological upper limit. There is a true leucocytosis of pregnancy in primiparæ. There is an absence of leucocytosis of digestion. The count is actually less during digestion.

Carstanjen says the neutrophiles are increased in pregnancy and decreased during the puerperium. The lymphocytes are decreased in pregnancy and increased during the puerperium. The large mononuclears are always decreased. The eosinophiles are decreased post-partum, and then on the seventh day of the puerperium they are increased beyond the percentage found in pregnancy.

C. Hahl examined 36 normal cases in pregnancy, labor, and the puerperium. The leucocytes were slightly increased in the last days of pregnancy. With labor there was a considerable increase due to the neutrophiles. Post-partum there was a gradual decrease, reaching the normal in one to seven days. His comparisons showed, with no contractions, no increase in leucocytosis; with contractions, a marked leucocytosis. His explana-

tion was that the process is similar to the leucocytosis in infectious diseases, poisons and malignant tumors: all are due to the presence of an irritant, chemotactic in nature, in the blood. For comparison, he noted the increase of leucocytes in the endometrium of pregnancy and in the muscular coat with a resultant increase in the blood stream. The increase in labor is due to mechanical compression from the uterus. If the leucocytes die young, there is a renewal of the supply from lymphatic sources, due to the circulating irritant.

Zangemeister and Wagner examined 47 cases of healthy non-pregnant women. Thirty-five showed a leucocytosis of over 10,000, and in one case 21,300, before the meal. In the majority of all pregnant women the leucocytosis ranges from 7,500 to 15,000. The authors found no difference between pregnancy and non-pregnancy, nor between primiparæ and multiparæ. In 63 labor cases they found leucocytosis in nearly every case, the maximum just post-partum, even triple the original count. The increase, they decided, was influenced solely by the progress of labor, and not by the para, age, or constitution. They likewise considered it influenced by the discharge of amniotic fluid. In the puerperium they found a rapid decrease, but a slight increase in the presence of severe after-pains.

Carton eliminated the digestion factor by taking counts at the same hour each day. In the ninth month of pregnancy he found a range of eight to fifteen thousand, with 70 to 80 per cent neutrophiles, and a decrease in the eosinophiles. In labor the polymorphonuclear neutrophiles were increased, especially in primiparæ, and there was an absence of eosinophiles. In the puerperium, from the first to the third day, there was a decrease in the neutrophiles, and an increase in the eosinophiles, up to 3.5 per cent.

Birnbaum found that in the second half of pregnancy there was almost always a slight leucocytosis in primiparæ, an average of 10,500, and seldom a leucocytosis in multiparæ—average 8,480. He found a marked increase in labor, especially among primiparæ, with the maximum reached on the third day of the puerperium. He found that the increase in labor was plainly related to the contractions, not related to the rupture of the membranes, and he found the differential count unchanged in pregnancy. In labor he found the neutrophiles increased, and the lymphocytes and eosinophiles increased.

Term I - II Cases	Leucocytosis 1-4 weeks AP	Differential Analyses in % Neutroph.	Smil lymph	Lge lymph	Eosin	Transit	Mast Cells
Average	10909	72.0	22.0	3.6	1.4	0.5	0.5
Highest	16800						
Lowest	8800						
P.P.-VI - 14 Cases	Leucocytosis	Neutrophs	Smil lymph	Lge lymph	Eosin	Transit	Mast Cells
Average	9886	70.1	22.3	3.9	2.7	0.5	0.5
Highest	12400						
Lowest	6700						

Chart 6. Pregnancy 1 to 4 weeks antepartum. (Michael Reese Hospital.)

Blumenthal says the leucocytes showed a slight increase in pregnancy, ranging from 3,400 to 11,000, with a predominance of large mononuclear leucocytes. In labor the neutrophiles were increased, the lymphocytes decreased, and the eosinophiles and mast cells absent. In the puerperium a normal leucocyte count was attained in one day.

Given found a slight increase in pregnancy and a marked leucocytosis, chiefly among the neutrophiles in labor and the puerperium. He found no difference between the primiparæ and multiparæ, and the increase was absent in cases of macerated fœtus and the presence of anuria. Two to three weeks post-partum there was a marked lymphocytosis, proportional to the speed of convalescence.

Arneth's chief contribution was a special classification of the polymorphonuclear neutrophiles, to which he ascribed a clinical significance. In the series presented here, this classification was made, but without meeting Arneth's expectations. In his classification, the neutrophiles are divided according to the construction of the nucleus into five classes. The first class contains a single round-celled nucleus; the second, two nuclei or nuclear parts, elongated or round; the third, three nuclei, or nuclear parts; the fourth, four; and the fifth, five, or more.

Para I - 30 Cases	Labor	Puerp. 1.	2.	3.	4	5	6	7	8	9	10
Neutrophiles	83.2	81.7	72.1	72.0	78.3	77.4	74.6	71.2	70.1	68.2	68.9
Small Lymphocytes	10.8	10.3	13.8	21.0	15.0	14.3	17.5	20.5	24.9	24.2	26.9
Large Lymphocytes	3.5	4.5	6.1	4.0	3.3	4.9	5.2	5.3	3.3	4.2	3.1
Eosinophiles	1.7	3.0	2.2	1.6	2.2	2.4	2.1	1.7	0.8	2.3	1.2
Transitional	0.3	0.1	0.2	0.8	0.6	0.5	0.3	0.5	0.4	0.5	0.3
Mast Cells	0.5	0.4	0.6	0.6	0.6	0.5	0.3	0.8	0.5	0.6	0.6
Para II - 57 Cases	Labor	Puerp.	2	3	4	5	6	7	8	9	10
Neutrophiles	77.7	79.2	73.1	73.0	71.7	72.6	68.5	69.4	66.3	67.2	64.3
Small Lymphocytes	16.3	12.8	19.3	17.5	22.5	21.8	23.1	23.5	26.4	26.4	28.8
Large Lymphocytes	4.1	5.3	4.1	5.9	3.0	3.1	5.2	4.6	3.6	4.2	3.1
Eosinophiles	0.5	1.1	2.6	2.1	2.0	1.4	2.3	1.3	2.8	1.6	0.8
Transitional	0.6	0.8	0.5	0.7	0.3	0.1	0.7	0.6	0.5	0.3	0.2
Mast Cells	0.8	0.8	0.4	0.8	0.5	1.0	0.2	0.6	0.4	0.3	0.8

Chart 1. Leucocytosis in labor and puerperium. (Michael Reese Hospital.)

In the last three classes there is a secondary division into round parts and loops. Arneth examined 10 pregnant women, 5 primiparæ and 5 multiparæ. In the primiparæ he found a count ranging from 7,800 to 11,000; in the multiparæ, from 3,000 to 8,600. He found the neutrophile changes to be a displacement toward the left; in other words, toward the first class of neutrophiles, or so-called young cells. The smaller the total count, the more the displacement toward the left; and he found the neutrophiles to belong chiefly to classes two and three. In labor he examined six primiparæ and two multiparæ. All the total counts but one exceeded 10,000—as high as 18,100. The displacement of the neutrophiles was still more to the left. In the puerperium there was a total decrease, with the displacement back toward the right of the scale. On the third day post-partum, in the presence of lactation, no influence on the leucocytes was noted, the count remaining unchanged, and the neutrophiles remaining toward the left.

His explanation was that, as in infections, there is a more rapid destruction of the leucocytes, resulting in an increase in the total and an increase in the young forms, that is, classes two and three; but the destruction is not so severe as to cause the appearance of chiefly class one cells.

Hans A. Dietrich laid special emphasis on the fact that he used the Turck counter and the May-Gruenwald stain for differentiations. He analyzed 20 cases, carrying the same women through pregnancy, labor, and the puerperium, examining them every two weeks ante-partum, and he made analyses of the labor counts at various stages, such as the rupture of the membranes, the beginning of

	Labor	Puerp. 1.	2	3	4	5	6	7	8	9	10	Duration Hrs. Ms.	Milk 2 3 4
Para I 30 cases	18255	19883	17069	15883	15007	14369	14800	13875	12033	10400	10600	19:25	7 13 9
Para II 19 cases	14347	16766	14640	12420	12510	11050	10000	11870	12110	13000	9000	12:49	11 8
Para III 15 cases	14560	16280	12930	12720	15440	12150	10530	11250	10800	10400	9000	11:55	6 9
Para IV 10 cases	13080	16800	14900	14800	12869	13200	9200	11500	11700	11200	10900	10:45	4 5 1
Para V 5 cases	10850	12000	9400	10650	9210	8600	7400	10400	9800	10800	10200	10:44	2 3
Para VI 3 cases	10467	11600	9600	7400	8000	8400	7850	6200	7200	9000	8600	7:50	2 1
Para VII 4 cases	12200	11300	11900	10700	9200	9400	10467	9533	5800	7200	7600	11:46	1 3
Para XII 1 case	5400	7200	7400	7000	6200	6800	6000	5800	6600	7000	6900	6:00	1

Chart 2. Effect of multiparity. (Michael Reese Hospital.)

pains, the height of pains, the birth of the head, and daily post-partum counts for eight days. All of this was done under identical external conditions, the patients being in the clinic, and all examinations being made three hours after the meal-time. Dietrich maintained that there can be no fixed normal maximum in pregnancy, such as the arbitrary figure of 10,000. Each individual has her own normal count. Hence, he determined to state his figures in terms of increase or decrease in the individual case, based on the low counts of pregnancy. On this basis he determined that at the end of pregnancy there is an increase over the normal in primiparæ of 3,068, and in multiparæ of 1,234. The increase is in the neutrophiles. The eosinophiles were decreased in 17 out of the 20 cases, and there were no appreciable changes in the lymphocytes. In labor among primiparæ there was an increase of 8,596 over the normal, and in multiparæ of 9,453; a maximum count of 34,200 — an increase of 18,500, and a minimum count of 16,400 — an increase of 2,600. The maximum point is reached just post-partum. The contractions seem to increase the count. On differential examination it proved to be purely a polymorphonuclear neutrophile increase. In 13 normal cases post-partum there was a rapid fall, reaching normal on the third day. The eosinophiles, absent in labor, reappeared on the first day of the puerperium, and then became more numerous than during the normal pregnancy. There was no relation to lactation or after-pains that he could determine.

Dietrich offered as an explanation of the leucocytosis a comparison to the theory of eclampsia, on the basis of toxins from the fœtus and placenta. These toxins in normal cases call forth as neutralizers the neutrophiles especially. Therefore, primiparæ have a greater number, and multiparæ have a certain immunity. Uterine contractions throw more toxins into the circulation, hence more neutrophiles appear from the bone-marrow.

Possibly the work theory of Schultz, offered by Hofbauer, namely, that increase in intra-abdominal pressure results in a compression of the veins and an increase in the circulation time, hence an increase in the leucocytes in the peripheral parts — in other words, an apparent leucocytosis may be a part of the explanation.

S. Adachi studied the blood changes in pregnancy and labor. He pointed out that variations in healthy non-pregnant women are marked. The figures given by various observers are: Moleschott, 12,605 to 14,000; Mallassez, 6,923 to 7,692; Duperie, 4,090 to 4,545, and Senator, 3,000 to 6,000. If there be such variations in the normal non-pregnant counts, the variations in the pregnant woman, or in any unusual condition, would

	Number of cases	Labor	Puerp.	2.	3.	4	5	6	7	8	9	10	Average Duration Hrs. Min.
Para I													
Under 12 Hours	6	17333	16900	12800	13800	13600	9800	14100	13530	10120	10800	9200	8:47
12-24 Hours	14	17830	18625	16700	14750	14450	15200	13760	12240	13650	8000	10440	18:07
Over 24 Hours	10	19360	22400	17943	18150	16875	14120	16100	16100	13600	11400	11100	27:37
Para II													
Under 12 Hours	11	15500	17800	15180	13470	13300	12000	9530	11870	10800	9000	8910	6:03
12-24 Hours	6	12100	14600	12500	11400	11200	10400	11400	10220	11070	13960	9000	15:19
Over 24 Hours	2	14800	17240	15800	11200	11920	10800	10540	14900	10650	11400	10200	34:37
Para II-XII													
Under 12 Hours	31	14580	15930	13825	13080	10540	10710	10530	10341	10420	10850	9000	6:00
12-24 Hours	23	11800	13800	12100	10420	12340	11620	9800	10633	9733	10215	11055	15:09
Over 24 Hours	3	14130	11200	9400	13400	14210	10800	7400	11996	11000	10990	10160	32:05

Chart 3. Effect of duration of labor. (Michael Reese Hospital.)

therefore be proportionately greater. He considered as important factors the apparatus and technique, condition of the subject, and the external factors. For apparatus, he used the Thoma-Zeiss counting chamber, but preferably the Turck. Hæmorrhage, fever, meal digestion, exertion, were factors to be considered in the condition of the patient. Room temperature was a factor in that cooling seemed to increase the leucocytes, and vice versa. Adachi counted ten non-pregnant cases, in whom he found an average of 5,500 to 8,400; 19 nine months' pregnancies, in whom with the Thoma he found 6,800 to 12,600, and with the Turck, 4,960 to 10,520; and 14 cases in active labor, from one-half to five hours antepartum, usually the second stage, in whom he found a range of 11,000 to 25,600 — in one case a 9,800 count. He found no increase in the ninth month of pregnancy over the non-pregnant state, in this agreeing with Zangemeister and Wagner. He found a marked increase in labor, proportional to the severity of the contractions. He counted 98 cases in all, omitting 30 for various causes, making his total in all groups 68 cases. However, he saw almost all his cases only once, or at most twice. His explanations are that in the ninth month of pregnancy there is no change in the leucocytes, erythrocytes or hæmoglobin; that in labor the leucocytes are increased proportionally to the contractions, and he found no difference between primiparæ and multiparæ, all of which conclusions are at variance with the findings of most other reliable observers.

W. Sieben analyzed 10 cases in labor and the puerperium. He was unable to make comparative counts on the same women through pregnancy, labor, and the puerperium. He found an increase in the ninth month of pregnancy, and approved strongly of Dietrich's method of following the individual case through her pregnancy, labor, and puerperium, rather than the Adachi method of numerous totals from all possible sources. In labor he found a leucocytosis maximum of 21,000, minimum of 11,000, average of 17,000, with a constant decrease in the puerperium of all cases but two, reaching the normal at the end of the second week. His differential analysis showed the neutrophiles to decrease throughout the puerperium, and determine the general curve. The lympho-

cytes increased a little on the first or third day, possibly in relation to infection. The eosinophiles were present in 50 per cent of the cases just post-partum, in which Sieben differs from most other authors, who have found them absent — an increase throughout the puerperium or reaching a maximum on the third day. The neutrophiles and the lymphocytes were found to be reciprocal, the one increasing as the other decreased. In the mononuclear lymphocytes, the transitional cells and mast cells, no rule applies. His conclusions were: (1) In labor there is an increase averaging 17,000. (2) There is a return to the normal in the second week. (3) In the differential analysis the polymorphonuclear neutrophiles decrease steadily throughout the puerperium. The lymphocytes, like the polynuclears, decrease, but may rise in a week to a figure greater than the labor total. This change occurs chiefly in the small lymphocytes. As the small lymphocytes increase, the large lymphocytes decrease. The eosinophiles were present in 50 per cent post-partum, and their curve was parallel to that of the neutrophiles.

No single worker analyzed a sufficiently large series to establish a standard scale, and the discrepancies between various investigators, together with the varying conditions under which their results were attained, made it seem impracticable to combine their figures even from only the more recent sources.

In this investigation single counts and differential analyses were made in 25 pregnant women (11 primiparæ and 14 multiparæ) one to four weeks before delivery, and counts were made in a consecutive series of 100 ward cases in labor, afterwards eliminating 13 because of fever (11 with one temperature of 100.2° or over and 2 with fever of several days' duration). In each of these women a leucocyte count was made during active labor, and once daily thereafter for ten consecutive days. Whenever possible, the blood was taken in late forenoon, late afternoon, or at night, i.e., when well removed from meal time. At the same time, spreads were prepared for differential counts, and the polymorphonuclear neutrophiles were subjected to the Arneth analysis in an attempt to confirm his findings.

	Number of Cases	Labor	Puerp 1	2	3	4	5	6
Para I-2nd Day	7	17740	18680	18600	14200	13120	12720	10600
3rd Day	13	18900	21150	16700	15520	15400	13480	14966
4th Day	8	16875	20460	17550	18100	15900	16500	17700
5th Day	1	14000	13280	16200	17600	17000	15200	14800
Para II 2nd Day	11	14200	15800	15710	13770	12460	11760	10500
3rd Day	8	14550	16000	12130	11600	14200	11200	11400
4th Day	0							
PII-XII 2nd Day	24	14290	15980	15620	12740	12360	11950	10260
3rd Day	31	12190	13800	11300	11700	12060	10620	10200
4th Day	2	13000	14000	10900	10300	11220	10100	9600
PI-XII 2nd Day	31	15068	16580	14290	13070	12520	12065	10660
3rd Day	44	14170	15970	12840	13830	13040	11470	11530
4th Day	10	16130	19168	16330	16540	14960	16320	16080

Chart 4. Effect of appearance of milk. (Michael Reese Hospital.)

In the last month of pregnancy the average count in eleven primiparæ showed 10,909, or 2,909 above the mean normal of 8,000 (if we accept the normal range as 6000-10,000) The multiparæ (14 cases, average 8,886) showed no change and the differential counts come very close to normal figures (Chart O).

Very early it was found that there is a striking difference between primiparæ and multiparæ, a point little emphasized in the literature. In this series it is very noticeable (Chart 1). Among 30 primiparæ the average labor leucocytosis was 18,255, and the average high point, 19,883, was reached on the first day of the puerperium, with a steady tapering off from that to the tenth day, 10,840.

Among 57 multiparæ (II-para to XII-para). the labor figure was 13,467, and the average high point, 15,062, again was reached on the first day of the puerperium, then tapering to 10,467 on the tenth day.

With each successive childbirth there seems to be a decreased reaction on the part of the leucocytes, a kind of immunity, if you please, and in this respect the single XII-para was striking (Chart II).

The duration of labor proved less of a factor than had been anticipated, a noticeable increase beyond the average leucocytosis

Para I Five year Groups	Number of Cases	Labor	Puerp.	2	3	4	5	6	7	8	9	10
18-20 years	8	19275	24400	17850	17400	16450	15733	14150	13600	14150	10800	11000
21-25 "	16	17905	17760	16166	15325	12840	13314	11600	13680	11400	10266	11600
26-30 "	5	16450	19333	18700	16600	15733	12900	14250	12200	12866	11333	10130
31-35 "	1	21400	22200	18600	18200	17800	20600	14000	10100	8600	11600	11200
P II - XII	No. of Cases	Labor	Puerp.	2	3	4	5	6	7	8	9	10
20 years	3	15800	16200	14600	14000	13600	11200	12000	9800	10200	9900	11200
21-25 "	12	13217	13400	11700	10570	12133	8500	9867	9600	10200	9200	9000
26-30 "	22	13470	16520	12675	12733	13771	11400	10120	10920	11200	10800	11100
31-35 "	12	15683	16030	15167	14367	12737	11520	10800	12150	11700	10200	9950
36-40 "	7	9133	9800	10400	10320	8050	9133	11500	8560	5800	8800	7200

Chart 5. Effect of age. (Michael Reese Hospital.)

occurring only in the primiparæ in labor over twenty-four hours (Chart 3).

The incoming of the milk seemed not to affect the leucocytosis, except possibly in the group of "fourth day" primiparæ, in which a secondary rise occurred on the third day, and the single "fifth day" primipara, who reached her maximum count on third day (Chart 4).

Cases grouped on the basis of age, each group covering a five-year period, showed the most marked elevation in the leucocyte count among the eight primiparæ, aged 18 to 20. Among the multiparæ there was nothing noteworthy except the group aged 36 to 40, seven in number, in which there was the least reaction, explainable, however, on the basis of multiparity rather than age (Chart 5).

The differential analyses are in accord with the findings of the more recent workers, notably Dietrich and Sieben. The leucocytosis is of the polymorphonuclear type, these elements reaching their maximum at the end of labor and on the first day post-partum, then rapidly and steadily decreasing, reaching normal proportions after five days in primiparæ and three days in multiparæ. The eosinophiles were absent in half the labor cases, reappeared in normal proportions on the first day post-partum, and at no time were noticeably increased.

The small lymphocytes were diminished as the polymorphonuclear leucocytes increased, and the large mononuclear, transitional forms and mast cells maintained normal percentages (Chart 6).

Classification of the polymorphonuclear leucocytes on the Arneth plan was carried out systematically, and showed the displacement toward the left, i.e., classes 2 and 3, of which he speaks, but this was not a constant finding.

SUMMARY

There is a leucocytosis of pregnancy, appearing in the ninth month, slight in amount, and especially noticeable in primiparæ.

The leucocytosis of labor is marked in primiparæ, averaging 18,255, and is increased by a duration of labor beyond twenty-four hours. It is less marked in II-paræ and is slight in III plus paræ.

The height of the curve in primiparæ and multiparæ is reached on the first day of the puerperium, after which there is a rapid and constant decline to the tenth day, at which time the curve is about at the normal level.

	Labor	Puerp.	2	3	4	5	6	7	8	9	10	Duration Hrs. Mts.	Milk 2 3 4
Para I – 30 Cases Average	18255	19883	17069	15883	15007	14369	14800	13875	12039	10400	10840	19:25	7 18 9
Highest	27200	24800	21200	19600	19600	20600	21000	18400	16200	11600	12200	36:25	
Lowest	11000	14600	9900	10000	8400	8000	8600	9600	8600	8000	7400	7:10	
Para II – 19 Cases Average	14347	16766	14640	12420	12510	11050	10000	11870	10870	11000	9000	12:47	11 8
Highest	22400	28800	22800	18600	16400	15000	13200	16800	15800	17400	14000	40:10	
Lowest	7200	7600	8800	6200	6600	8000	5800	5400	9600	9400	7800	3:00	
P II–XIII – 57 Cases Average	13467	15062	12840	12014	11693	11070	9967	10716	10273	10867	10467	11:36	24 31 2
Highest	24600	28800	22800	18600	16400	15000	14200	16800	15800	17400	14000	40:10	
Lowest	5400	7600	7400	6200	6200	6200	5800	5400	5800	7800	7800	2:30	
P I–XII 87 Cases Average	15080	16900	14473	13220	13060	12457	12039	11544	10654	10620	10600	13:09	31 44 11
P III–XII 38 Cases Average	13027	14210	11940	11811	11285	11080	9950	10140	10000	10800	11200	10:54	13 23 2

Chart 6. Differential analyses in per cent. (Michael Reese Hospital.)

The onset of lactation does not influence the leucocyte count, except that in the "fourth day" primiparæ there is a slight secondary elevation on the preceding day — about 1,500 to 2,000.

Age is not a factor, except in primiparæ aged 20 years and under, in whom the leucocytosis is higher than in any other group.

Differential analysis showed the increase in leucocytes to be chiefly in the polumorphonuclear neutrophiles with a return to normal proportions by the third day of the puerperium, an absence of eosinophiles in about half the cases in labor, and their reappearance in normal proportions on the first day of the puerperium. The lymphocytes, large and small, mast cells and transitional types, showed nothing unusual.

The Arneth analysis showed a displacement toward the left, i.e., toward classes 2 and 3, but this was not constant, and no pertinent deductions could be drawn.

To my chief, Dr. Lester E. Frankenthal, I wish to express my deep appreciation of the privileges afforded me in the Michael Reese Maternity Wards, and for his helpful suggestions and invaluable criticisms in the carrying out of this work.

BIBLIOGRAPHY

ADACHI, S. Beitr. z. Geburtsh. u. Gynaek., 1912, xvii, 174.
ARNETH, J. Arch. f. Gynaek., 1904, lxxiv, 145.
BIÉGOUNE, O. Arch. Russ. de Path., 1898, vi, 70.
BIRNBAUM, R. Arch. f. Gynaek., 1904, lxxiv, 206.
BLUMENTHAL, R. Beitr. z. Geburtsh. u. Gynaek., 1907, xv, 414.
CARSTANJEN, M. Jahrb. f. Kinderh., 1900, iv, 684.
CARTON, P. Ann. de gynec. et d'obst., 1903, ix, 161.
DIETRICH, H. A. Arch. f. Gynaek., 1911, xciv, 383.
GIVEN, J. C. M. J. Obst. & Gynæc., 1906, ix, 261.
HAHL, C. Arch. f. Gynaek., 1902, lxvii, 485.
HIBBARD and WHITE. J. Exp. Med., 1898, iii, 639.
HOFBAUER, J. Monatschr. f. Geburtsh. u. Gynaek., 1897, v, Supplement, 52.
MOCHNATCHEFF, FRAU. Arch. f. Gynaek., 1889, xxxvi, 277.
NANNICINI, J. Arch. ital. di ginec., 1899.
NASSE, H. Untersuchungen z. Physiol. u. Path., 1839, ii, 150; cited in Hahl, C.
PAYR, A. Arch. f. Gynaek., 1904, lxxi, 421.
RIEDER. Beitr. z. Kenntnis der Leucocytose, usw., 1892.
SIEBEN, W. Beitr. z. Geburtsh. u. Gynaek., 1914, xix. 236.
VIRCHOW, R. Cellularpathologie. 3rd ed., 1862, p. 179; 4th ed., 1871, p. 167.
WILD, M. Arch. f. Gynaek., 1897, liii, 363.
ZANGEMEISTER, W., and WAGNER, M. Deutsche med. Wchnschr., 1902, xxxi, 549.

PERITHELIOMA AND ENDOTHELIOMA OF THE UTERUS[1]

By W. A. NEWMAN DORLAND, A.M., M.D., F.A.C.S., Chicago
Professor of Gynecology, Post-Graduate Medical School of Chicago; First Lieutenant, Medical Reserve Corps, U. S. Army

A CASE OF PERITHELIOMA OF THE UTERUS

IN October, 1907, a tumor of unusual scientific interest fell into my hands. The clinical and pathological findings were these (33):

The patient, a fragile, single woman, 65 years of age, had been complaining of pain in the pelvic region for a little over two months. She had visited a woman physician of considerable ability, who had made a vaginal examination and had pronounced the condition rheumatism of the pelvis. The patient was placed on a suitable course of treatment, but without any amelioration of the symptoms. On the contrary, the pain grew more severe, and the patient was referred to me.

Examination. I found the woman anæmic and thin almost to gauntness. Her skin was shriveled, and on the abdominal surface could be pinched up in thin folds. It was sallow or pale yellowish in color. After considerable difficulty due to the extreme modesty of the patient, I succeeded in making a vaginal exploration, when the following points were elicited: The vagina was small and undergoing senile changes. The vulvar mucosa showed the characteristic smooth, yellow appearance of senility. The uterus lay anteriorly, was small, although larger than would be expected from the age of the patient, and was distinctly sensitive to the touch. There was a very slight discharge from the os, sanguineous, but without odor or any decided appearance of hæmorrhage. At no time had the patient suffered from bleeding, nor had she at any time noticed any odor to the small amount of leucorrhœa of which she complained. The history of the patient, her age, the condition of anæmia, and the local signs impressed on me the importance of making a microscopic examination of the intrauterine curettings, and after considerable opposition this was finally agreed to. Under ether anæsthesia the uterus was scraped at the patient's home and a considerable quantity of débris obtained. The examination at this time confirmed the findings of the previous exploration, and also demonstrated the absolute mobility of the uterus and the healthy condition of the ovaries and tubes. The scrapings were sent to the distinguished pathologist, Dr. A. O. J. Kelly, since deceased, who reported that they showed an unusual condition of great malignancy which warranted the immediate removal of the uterus. He, at this time, pronounced the growth a perithelial sarcoma, the small tumor-cells showing an unusual degree of grouping around the vessel walls.

Operation. Two days later, notwithstanding the general unfavorable condition of the patient, I removed the uterus and tubes, performing a panhysterectomy. This, at the urgent insistence of the patient, was done at her home. I was ably assisted by Drs. H. A. Slocum, G. A. Knowles, and F. A. Faught, and two skilled nurses. The operation was simple and uncomplicated taking not more than thirty minutes for its completion. The patient made an uninterrupted recovery for three days. Then symptoms of bowel-obstruction supervened, and despite the use of eserin and the other remedies and measures generally employed in this condition the patient sank steadily and died of adynamic ileus on the evening of the fifth day. Lavage was not resorted to on account of the age and feeble condition of the patient.

Pathologic report. Dr. Kelly's report of the pathologic examination of the specimen follows: "The scrapings consist of a new-growth made up of a framework of fibrous connective tissue supporting large cylindrical cells, with clear vesicular nuclei. The connective-tissue stroma is quite scanty and in some places altogether wanting. The tumor-cells, for the most part, are arranged radially about and attached directly to capillary blood-vessels—whence, morphologically, the term 'perithelial sarcoma, seems justified. In other places there is a diffuse infiltration of the tissue—endometrium and musculature—by the tumor-cells. The uterus is rather small and reveals at the fundus a rough excrescence about 2 centimeters in diameter projecting into the cavity and infiltrating the wall of the uterus to a depth of seven to ten millimeters. Microscopically, the growth consists of a connective-tissue stroma enclosing epithelial cells arranged after the manner of the glands of the endometrium. In general this glandular arrangement is more or less well preserved, but in many places it is altogether wanting, and the epithelial cells infiltrate the tissues irregularly, as is common in this type of tumor."

This case is established, therefore, as one of the earliest recorded instances of perithelioma of the uterus, one of the rarer group of endothelial tumors.

THE ENDOTHELIUM AND THE PERITHELIUM

In order to comprehend the difference and yet the very intimate relationship existing between the two groups of endothelial tumors about to be analyzed, it becomes imperative to appreciate the exact anatomical variation

[1] Read before the Chicago Gynecological Society, April 21, 1916.

between the structures known as the endothelium and the perithelium.

It was His (70) who invented the term *endothelium* for the flat cells composing the inner lining of serous cavities as well as of the blood-vessels and the lymph-vessels. These cells have a definite origin from the mesenchyma — a layer of the primitive mesoblast— as Courtauld (27) established by his investigations of the newly forming blood-capillaries in very early placental tissue. Courtauld proved conclusively that the endothelial cells originate in the loose connective tissue of the chorionic villi and that the epiblastic layers have no share whatever in the process. It is obligatory, therefore, that neoplasms originating from these cells must be grouped with the mesoblastic growths, side by side with the sarcomata, whatever their histological appearances may be. They must be sharply differentiated from the carcinomata notwithstanding their many points of resemblance to that group of tumors. Because of their phylogenesis, Lazarus-Barlow (97) remarks that such tumors must be expected to show—as they do—a great variability of appearance, ranging between that presented by a typical spheroidal-cell carcinoma on the one hand and a typical sarcoma on the other. While both sarcoma and endothelioma, therefore, have their origin in the mesenchyma, it is probable that the sarcomata arise at an earlier and more primitive stage of mesenchymal development as is proved by their earlier clinical appearance, that is in children and patients of tenderer years.

In describing the endothelium, Lazarus-Barlow (96) states that normal endothelial cells are regularly arranged, are flattened and round, "with a large round or oval nucleus, and with a large amount of protoplasm to the cell. As a rule, the chromatin is collected round the periphery of the nucleus and also in the center, while strands of chromatin extend between the two. Hence, in section, the nucleus is remarkable by its clearness and its appearance of vacuolation." Mallory (112) adds that the endothelial cell is characterized by no production of fibrils, hence it stands out in marked contrast to the neuroglia cell. These endothelial cells are found in special regions, notably in the blood-vessels, the lymphatics, and the lymph-spaces.

The *perithelium*, on the other hand, is the layer of endothelial cells which surrounds the capillaries and smaller blood-vessels; that is, the external boundary or adventitia of the vessels running through the perivascular spaces, but not the cells forming the external wall of these spaces. Eberth and Iwanoff (35), in 1870, first described the perithelium in the vessels of the pia-mater and demonstrated them by staining with silver nitrate. Zeit (198), who in this country has probably most thoroughly studied these tissues, emphasizes the fact that "the perithelial membrane must be differentiated from the *perivascular lymph-spaces* of His" (70), which that anatomist described as "surrounding the adventitia of arteries, veins, and capillaries of the central nervous system (which has no lymph-vessels). The perithelium," Zeit repeats, "is the outer lining of the adventitia of blood-vessels, outside of which is the perivascular lymph-space." In 1871, von Ebner (36) described the perithelium in the vessels of the pineal gland, the suprarenal capsules, the thymus gland, and the salivary glands; Waldeyer (192) and Sertoli (166), in 1868, described it in the vessels of the coccygeal gland; and Paltauf (127), in 1892, reported its presence in the carotid gland.

THE HISTOLOGIC FEATURES OF PERITHELIOMA AND ENDOTHELIOMA

As is true of all other tissues, it is possible for neoplasms to develop from these delicate membranes. Stolz (176) calls attention to the fact that Golgi as early as 1869 first spoke of an *endothelioma* as a growth originating from endothelial cells, while Kolaczek (84), in 1878, made the first great analytical study of endothelial tumors and recognized the condition as belonging to the group of angio-sarcomata. Marchand (113) and Weichselbaum, in 1879, carried on these investigations, both regarding the endotheliomata as tumors *sui generis*. Maurer (116), in 1892, gave the name *perithelioma* to the endothelial tumors arising from the adventitia of the blood-vessels. Finally, Ribbert (149), in 1901, stated that the endothelial tumor aris-

ing from the blood-vessels is a very rare growth—much more so than that arising from the lymph-channels, and this observation is verified by the summary of all recorded endothelial tumors accompanying this paper.

It is unfortunate that there has been some confusion in the employment of these terms. The following résumé may aid in elucidating the matter. Under morbid stimulation endothelial cells, wherever found, will proliferate, and this proliferation may take place inwardly or outwardly or in both directions at the same time. In the words of Lazarus-Barlow (96), who, with Bayon (11), the English pathologist, has given this subject exhaustive attention: "Outward proliferation will lead to the production of a central space lined with endothelial cells, and surrounded by two, three, or many layers of cells, more or less regularly arranged, and with characteristic nuclei. Such a growth springing from the adventitia of a blood-vessel is designated a *perithelioma*." The important point to note, morphologically, is the persistence of the central lumen. Lazarus-Barlow believes that this characteristic feature is doubtless due to the greater rapidity with which the blood flows through the capillaries together with the high hemal tension, both of which militate against cellular proliferation inward. His conclusion that because of these physical peculiarities entheliomatous growth should be more common in the case of lymphatics and peritheliomatous growth in the case of blood-vessels is verified clinically and by the histological findings of all recorded endothelial tumors. It must be admitted, however, that it is difficult in some cases to definitely conclude where the growths originated, although the presence of red blood-corpuscles in the lumina of peritheliomata will usually determine their origin from the blood-vessels. "If," adds Lazarus-Barlow, "the growth shows lumina containing a fairly circumscribed mass of albumin which has undergone coagulation in the process of fixation and has given rise to fibrin and a certain amount of granular débris, the growth has probably originated in a lymphatic."

If, on the other hand, the proliferation of the endothelial cells takes place inwardly, the central space lined with endothelial cells will become choked with a mass of cells. Such a growth is known as an *endothelioma*. "According to these two hypothetical methods of growth," continues this pathologist, "it should be possible to divide the endotheliomata into the '*peritheliomata*' and the '*entheliomata*.' Further, if the perithelioma process occurs in different situations, but in close contiguity, the effect will be that of a number of spaces, each more or less closely resembling the original space, but separated from one another by a mass of cells produced by the outward proliferation and coalescence of the endothelial lining. On the other hand, in a growth of the endothelioma type a number of cell-masses will be seen corresponding to normal lymphatic spaces, in which the lumina have been distended and filled with cells, and which are separated by ordinary connective tissue. A combination of the two processes may occur, leading to a type of growth that may fairly be called a '*perienthelioma*.'" To this distinction Bayon (11) adds that "all growths presenting a radial disposition of cells around blood-vessels," the endothelial lining of which is intact, "may be termed *peritheliomata*, even if it cannot be conclusively shown that they originate from the perithelium," that is, from the endothelial cells covering the adventitia of the blood-vessels.

HISTOLOGIC CONCLUSIONS CONCERNING ENDOTHELIAL TUMORS

As a primary corollary, then, it may be stated that both endotheliomata and peritheliomata are, in reality, endothelial tumors, that is, taking their origin in endothelial cells; and, secondly, that they are more remotely still very closely allied to, if not constituting a true variety of, sarcomata. Moreover, from a morphologic standpoint, it is evident, from the foregoing analysis, that it is admissible to use the expression "*peritheliomata*" to designate only a peculiar class of the growths springing from the delicate external layer of cells around the minute blood-vessels and showing the characteristic radial disposition of the tumor-cells which,

according to von Hansemann (60), is due to the growth-cells being more readily nourished in that position. The characteristic cellular proliferation begins at the external wall of the vessel and not in its lumen, as in simple hæmangio-endothelioma; but they are not, as Barbour (10) claims, in reality endotheliomata derived from the lymphatics. Zeit (198) emphasizes this distinction when he remarks, "it is wrong to speak of a *perithelioma* as arising from a lymph-vessel, because perithelial membranes cover the outer surface of the adventitia of blood-vessels only in a one-cell layered mosaic of flat endothelium-like cells. They have only been found with blood-vessels of certain organs called perithelial organs. A perithelioma cannot, therefore, be spoken of as arising from lymph-vessels nor from blood-capillaries. The term *perithelioma* is confined to certain tumors of the blood-vessels of perithelial organs only. Yet so-called perithelial tumors or angiosarcomata do occur in non-perithelial organs which are morphologically similar to the true peritheliomata. From a histogenetic point of view it is desirable that the term be reserved for a class of tumors arising from perithelium only."

With this reservation Zeit concludes: "In order, then, to arrive at a histogenetic classification of these tumors we would have to be able to distinguish whether the proliferation of cells had their origin in the true perithelium of blood-vessels which lines the outer surface of the adventitia in perithelial organs (*perithelioma*); in the inner or both endothelial layers of a perivascular lymph-space; or in the adventitia cells or perivascular cells of blood-capillaries. Pick (134) and Rosthorn (155) call all these endothelium-like layers *perithelium* and their proliferation a *perithelioma*. Borst (19) also wants to use the name perithelioma for all these tumors, with the understanding that it is a kind of offspring of endothelioma. In case one is able to prove that the growth originated from the endothelium of the perivascular lymph-spaces, it should be called *endothelioma perivasculare* (Borrmann's (18) *periendothelioma*). Borrmann thinks he can distinguish morphologically between the two types as follows: *perithelioma*, when the vessels are surrounded by many layers of cells which are arranged [with their long axes] radially and vertically to the wall of the vessel; *periendothelioma*, when the vessels are surrounded by many layers of cells which are arranged concentrically around the wall of the vessel." Zeit differs with this view, and prefers to use the name *hæmangio-endothelioma perivasculare* for the so-called perithelial or perivascular tumors. On the other hand, the *hæmangio-endothelioma intravasculare* of Zeit originates only from blood-capillaries, "and has been called by Ziegler, *hæmangioma hypertrophicum;* by Nawerck, *hyperplastic capillary angioma;* and by Borrmann, *capillary endothelioma*. These tumors consist of a stroma of fibrous tissue with gland-like tubes filled with blood and lined with one layer of endothelial cells which may be cubical or cylindrical in shape."

THE CLINICAL ANALYSIS OF ENDOTHELIAL TUMORS

With this hasty summary of the histological distinctions between the two groups of endothelial neoplasms, it is interesting to proceed to an analytical study of the clinical peculiarities of these tumors with special reference to their occurrence in the female generative organs. An exhaustive investigation of endothelial tumors was made by Rudolph Volkmann (190), in 1895, and more recently by Max Borst (20), in 1902; while Zeitschmann (200) has presented an exceedingly interesting treatise covering the recorded information, up to 1904, concerning perithelioma as occurring in lower animals.

At the most, not more than 300 endothelial tumors of all kinds have been recorded to date in the various portions of the human body. It must be conceded, therefore, that they are among the rarest of neoplasms; although it is probable as Roussy and Ameuille (156) have claimed, that they are commoner than would appear, and that many cases were formerly described as angiosarcoma and angiosarcoma plexiforme.

Any part of the body may be attacked by the growth. The commonest sites of surgical interest, according to Carless (26), ap-

pear to be the skin, testes, throat, the parotid and submaxillary glands, the neighborhood of the mouth and cheeks, the long bones, and the carotid gland. Other regions in which authentic cases have been noted are the eyelid, the optic nerve, the soft palate, the pelvic connective tissue, the brain, the subcutaneous connective tissue, the muscles, the kidney, the mamma, and certain serous membranes, as the pleura. Wherever occurring, these tumors show a marked tendency to undergo hyaline degeneration.

In their relation to *sex*, Carless states that endothelial tumors are slightly more common in women than in men. Karsner (77) endorses this statement. *Age* exerts a decided influence upon the growth. Only 26.13 per cent of the cases occur before the age of 40, and 73.87 per cent after that age. Karsner claims that the disease appears particularly in the fourth, fifth, and sixth decades of life, that is, between 31 and 60 years of age.

About one-third of all the recorded cases have occurred in the female generative organs. Thus, Lange (94), up to 1903, collected over 40 cases of endothelioma of the ovary. Since then additional cases in the ovary have been reported by Godart (54), Lincoln (106), Schuermann (163), Federlin (40), Papaïannou (128), Heinricius (65), Procopio (141), Kubo (92), Carl (25), Eymer (39), and Ligabue (103). Perithelioma of the ovary is much rarer, but fifteen cases in all having been recorded by Steinhaus (175), Burckhard (24), Krukenberg (90), Menetrier (117), Graefe (56), Pollak (139), Mirabeau (121), Góth (55), Uffreduzi (184), Neumann (125), Amann (5), Bender and Proust (14), and Barbour and Watson (10). Karsner (77) records a case of primary endothelioma of the omentum; Schmidlechner (162), a case of perithelioma of the labia majora; and Barbour and Watson (10), a case of perithelioma of the fallopian tube.

ENDOTHELIAL TUMORS OF THE UTERUS FROM THE CLINICAL POINT OF VIEW

Macnaughton-Jones (109) correctly remarks that it is only within recent years that uterine endothelial tumors have been described. Comparatively few of these cases are on record, and this is especially true of perithelioma; but, as Watson (193) has remarked, "the condition cannot be so rare as the small number of cases indicates. Many of them have been described as sarcomata, and many others, occurring as secondary changes in fibroids, have not been recognized at all." In a large percentage of the cases the tumor has arisen in a pre-existing fibroid, or has itself formed a large tumor in the uterine wall which has been mistaken for a fibroid. A few of the cases, as Watson's and my own, were unassociated with perceptible tumor-formation, having apparently originated in the corporeal mucosa. Now that the existence of these tumors is becoming more generally recognized as well as their intimate association with a pre-existing fibroid change in the uterus, it is very probable that a progressively larger number of endothelial tumors will be placed on record in surgical literature. It is at least suggestive, as Lazarus-Barlow (96) states, that in the Middlesex Hospital in London, where a careful pathological examination of every tumor is made, during the period from 1900 to 1904 endothelioma constituted 10 per cent of the malignant tumors of the uterus.

I have been able to gather from the literature just 50 cases of endothelial new-formations in the uterus, of which 18 were of the peritheliomatous type and 32 endotheliomatous. These are grouped in the tables which are appended with the exception of Svoboda's (177) case of endothelioma of the cervix and Szerszynski's (178) and Zembrzuski's (199) cases of perithelioma, the records of which were not accessible. It is interesting to note that two of these cases occurred in the work of members of this Society. It is to be regretted that the clinical and pathological reports of some of these cases are very incomplete, but even so a critical review of the cases elicits interesting and suggestive points. Thus, the tables verify the claim already made that endothelioma is much more frequent than perithelioma — about in the proportion of 2 to 1.

Age. The average age of all the cases was 46 years. Perithelioma seems to develop a little later than endothelioma, the cases

averaging 48¼ years, while the average age of the endotheliomata was 43¾ years.

The social relations of the patients are not recorded in 11 cases. Seven of the women were single and 29 were married, with from none to nine children. One of the women was but 18 years of age, another 19, and a third 27; the rest were 30 and older, the oldest woman being 68 years of age, the next oldest 65, a third 64, and two 62 years old. Sixteen of the women were 50 years old or more. As two-thirds of the women with uterine sarcoma are below the average in childbearing, have not reached puberty, or have not borne children for a long time, a striking clinical difference will here be noted between uterine sarcomata and endothelial tumors.

Symptoms. Bleeding, at times amounting to flooding, at times merely a slight show, is a very persistent symptom, only 5 of the cases giving no such history. At a later period in the course of the disease these women would probably have developed the symptom. Generally, the clinical manifestations are those of malignancy—bleeding, fetid, purulent discharge and pain—or those of fibroid tumor—bleeding with a decided tumor-mass or uterine enlargement. The cases give a death-rate of 29.79 per cent, including the primary mortality—17 per cent—and death from later complications and recurrence.

Site of the tumor. Of the peritheliomata, but one originated in the cervix, while of 31 endotheliomata the location of which are noted, 16, slightly over half, sprang from the cervix—7 from the posterior lip, 4 from the anterior lip, and 5 from the cervix generally without special localization. But 2 endotheliomata developed in the fundus and right cornu; while 12 were located in the corpus, 2 involving the posterior wall and 10 the anterior. Six of the peritheliomata originated in the fundus and 10 in the body of the uterus. It would appear, therefore, that endotheliomata preferably develop from the cervix and peritheliomata from the uterus itself.

THE ASSOCIATION OF ENDOTHELIAL TUMOR WITH OTHER NEOPLASMS OF THE UTERUS

Leith (98), in the Ingleby Lectures for 1910 upon the pathology of tumors of the corpus uteri, and Shaw (167), in 1913, both call attention to the frequency with which these endothelial growths in the uterus occur in association with, or actually within the tissues of, fibromyomata, and especially when there has been no pre-operative suspicion of malignancy. Shaw remarks that this may possibly account for the few cases recorded, many doubtless being thrown away as fibromyomata without microscopic examination. Of the tabulated cases, 19 were associated with fibromata or fibromyomata, while in 25 cases no such tumorous formation was noted. All the fibroid tumors which had undergone the malignant degeneration were located in the body of the uterus, thereby substantiating the claims of Montgomery, Weir, Williams, and others that sarcoma of the body of the uterus is more common than sarcoma of the cervix.

In 1860, C. Mayer first described uterine sarcoma, his case being termed by him a sarcomatous polyp. The occurrence of sarcomatous change in fibromyomata was first clearly described by Virchow (187), in 1862, who pointed out the origin of these tumors from the connective tissue of the myoma. In 1867, G. Veit first described sarcoma of the cervix. Finally, Geist (52), in 1913, while speaking of malignant changes in uterine fibroids with special reference to the histogenesis of sarcomatous change in these tumors, remarks: "The interstitial tissue of the myoma, and the adventitia and endothelium of the lymph and blood-vessels have been recognized and accepted as sites of origin of sarcoma. To these must be added the muscle-cells proper [of a myoma]." Leith (98) adds suggestively, "We thus have a variety of sarcomatous growths arising within fibroids—the endothelioma, the perithelioma, the myosarcoma, and the myoma sarcomatodes, which may be the explanation of the relatively low degree of malignancy exhibited by most of these growths. Those originating in fibroblasts, though varying greatly in malignancy, show it in greatest degree, whilst the myosarcoma is the least malignant of all, the other two forms showing varying intermediate degrees." Bayon (11) confirms this view as to the relatively low degree of malignancy of

endothelial tumor, stating that metastases are not at all frequent with these tumors, which is diametrically opposed to the general expectation when there is taken into consideration the extreme vascularity of the tumors, their intimate approximation to the blood-vessels, and their multiplicity of small cells. They are, however, he adds, characterized by infiltrative and rapid expansive growth, but on complete and thorough operative procedure do not show a tendency to recur.

CONCLUSIONS

The following deductions may be drawn from this pathological and clinical review:

1. Endothelial tumors of the uterus develop late in life—much later than sarcomata—the peritheliomata generally occurring at the most advanced age.

2. These growths are especially prone to occur in a pre-existing neoplasm—a myoma or a fibromyoma.

3. While showing a high degree of local malignancy they but rarely give rise to metastatic deposits elsewhere.

4. It is probable that endothelial uterine tumors occur more frequently than would appear. Hence the importance of early removal of all uterine growths, which should always be subjected to a careful pathologic examination.

TABLE OF ENDOTHELIAL TUMORS OF THE UTERUS

(Chronologically arranged)

I. PERITHELIOMA

CASE 1. Reported by Mary Scharlieb, Med. Press and Circ., March 28, 1906, p. 335. Patient aged 44, single pregnancy. *Clinical history.* Flooding three years ago, curetted. For last six months increasing menorrhagia; no pain. Flooding from November 3, 1905. Uterus slightly enlarged. Slightly irregular. Small nodules, best felt per rectum. Operation, November 16, 1905. *Macroscopic findings.* Uterus slightly enlarged. Small fibroid tumors upon fundus and posterior wall. Mucous membrane shows circumscribed area of malignancy. *Microscopical findings.* Uterine muscle not invaded by glandular tissue. Diseased endometrium shows tubules of cells, actively proliferating. Growth springing from outer wall of blood-vessels. Supravaginal hysterectomy. Recovery.

CASE 2. Reported by Mary Scharlieb, ibid. Patient aged 50. IX-para, youngest child sixteen years. *Clinical history.* Menses regular till end of 1904. Since then free discharge, recently blood-stained. For three months lump in abdomen. Weakness. Frequent micturition. Large hard tumor felt in abdomen; irregular. Os patulous with papillomatous mass protruding. Operation, November 10, 1905. *Macroscopic findings.* Uterus and appendages weigh 31 ounces. Uterus size of 4½ months' pregnancy; 6¼ inches long; 4½ inches wide; outer surface smooth. Cervix much enlarged. Growth has perforated left side of uterus, and projects as irregular mass into left broad ligament; tumor involves anterior lip of cervix. On section, solid tumor fills cavity extending into the cervix attached to anterior wall; mass measures 3 inches in antero-posterior diameter. Posterior wall of uterus lined by much thinner but very irregular layer of growth. Tumor firm; uniformly yellowish-white color; cavity of uterus, 9 inches long. *Microscopic findings.* Sections of tumor show columns of cells embedded in connective tissue. Columns have central cavity containing blood and lined with endothelium. This is bounded by a vascular wall of varying thickness, which is surrounded by a thick layer of tumor-cells, giving the appearance of a growth composed of a collection of vascular tubes, the outermost cells of which are formed by masses of tumor-cells. Cells have large amount of protoplasm, round, deeply-staining nuclei and nucleoli. The amount of interstitial tissue varies. Supravaginal hysterectomy. Recovery, but continued growth of tumor.

CASE 3. Reported by E. H. Tweedy, Tr. Roy. Acad. Med., Ireland, 1907, xxv, 317; also personal communication. Patient aged 34. II-para. *Clinical history.* Operation, 1906. Pain in abdomen and back. Slight leucorrhœa. Menstruation normal. Losing flesh for year and a half. *Macroscopic findings.* Uterus uniformly enlarged, with some fibroid induration. Certain small nodules lie under the peritoneum. Main tumor situated at fundus. Peritoneum studded with small nodules. *Microscopic findings.* Sections of nodules show masses of fairly large flat cells, arranged in a somewhat columnar manner and infiltrating the muscle-bundles. This condition is quite general over the whole fundus. Supravaginal hysterectomy. Death on the following day.

CASE 4. Reported by G. F. D. Smith, J. Obst. & Gynæc., Brit. Emp., 1908, xiv, 331. Patient aged 38. Single. *Clinical history.* Irregular bleeding for five months. Uterus small, freely movable. Operation, July 30, 1906. Double ovariotomy in 1904. *Macroscopic finding.* Uterus small; 3 inches long, 2½ inches internally; external surface normal. From the fundus projecting downward into the cavity is a soft, friable growth, paler than the surrounding mucous membrane. *Microscopic findings.* Tumor-cells slightly elongated in shape, springing from the periphery of the smaller vessels. Areas of necrosis. Tumor-cells infiltrate the uterine muscle at the point of attachment of the growth. Total hysterectomy. Recovery.

CASE 5. Reported by W. A. N. Dorland, J. Am. M. Ass., 1908, li, 1227. Patient aged 65. Single. *Clinical history.* Pain in pelvis for two months. Uterus slightly enlarged, anterior. Slight leucorrhœa, sanguineous, odorless. No bleeding. Operation, October, 1907. *Macroscopic findings.* Uterus not much enlarged. At the fundus a rough excrescence, 2 centimeters in diameter, projecting into the cavity and infiltrating the uterine wall to a depth of 7 to 10 milimeters. *Microscopic findings.* Section of growth shows connective-tissue stroma enclosing epithelial cells, arranged after the manner of the endometrial glands. The scrapings consist of a framework of fibrous connective tissue, supporting large cylindrical cells with clear vesicular nuclei. These cells are arranged radially about and attached directly to capillary blood-vessels. Panhysterectomy. Death on fifth day from adynamic ileus.

CASE 6. Reported by Doran and Lockyer, Proc. Roy. Soc. Med., vol. ii, Obst. and Gynec. Sect., 1908, Oct., p. 25.

Patient aged 49. V-para. *Clinical history.* Abdomen enlarged for seven years; girth 54 inches. Occasional irregular bleeding. *Macroscopic findings.* Fibroid uterus associated with fibroma of right ovary—weight, 15 pounds. Uterus size of two fists. Cystic fibroid tumor as large as the uterus springing from the fundus. *Microscopic findings.* Section of tumor shows small round cells lying in close connection with numerous blood-vessels, and appearing to arise from their outer coats. These cells resemble sarcoma-cells. The blood-vessels have fairly thick walls, and are in no sense embryonic like the blood-vessels of ordinary sarcoma. Hysterectomy. Recovery. No recurrence.

CASE 7. Reported by Doran and Lockyer, ibid. Patient aged 36. II-para. *Clinical history.* Abdomen enlarged for fifteen months. Menstruation profuse and irregular. *Macroscopic findings.* Multinodular fibroid tumor of uterus—weight 2½ pounds. A perithelioma invades the uterine wall, left fallopian tube, mesosalpinx, left ovary, and a cystic tumor springs from left side of uterus. *Microscopic findings.* Section of tumor shows numerous small, smooth, pea-like cells, springing from the adventitia of the blood-vessels. These lie in large oval collections in alveolar spaces among the muscles of the uterus and tube. These cells resemble in size, shape, and staining characteristics the cells of the lymphomatous stroma of the endometrium. Hysterectomy. Recovery. No recurrence.

CASE 8. Reported by J. Ewing, Proc. N. Y. Path. Soc., 1908, viii, 85. Patient aged 48. Married. *Clinical history.* Menopause 3½ years ago. There was irregular bleeding, at times profuse. Three months later a foul discharge. Uterus enlarged, tender, os patulous. Large spongy tumor felt in uterine cavity. *Macroscopic findings.* Solid, round, polypoid tumor, 10 x 6 cm., firmly adherent over anterior wall of uterus; fragile. Section streaked with extensive necrotic areas. *Microscopic findings.* Section of tumor shows structure distinctly that of hypernephroma. Polyhedral cells in close apposition, with well-defined borders, clear or granular protoplasm and vesicular nuclei; size, 15 to 30 micra. Near the blood-vessels the smaller cells predominate. Mitotic figures with well-preserved spindles are very numerous, especially in the deeper portions near the muscularis. No sinuses and no villi are found. Hysterectomy. Recovery.

CASE 9. Reported by R. F. C. Leith, J. Obst. & Gynæc., Brit. Emp., 1911, xix, 447. Patient aged 45. Married; nullipara. *Clinical history.* Menopause at 42. At 39 was tapped for a cystic abdominal tumor, and thirteen months later an abdominal section, but the growth was not removed because of adhesions and collapsed condition. At 44, increasing abdominal swelling; incontinence of urine. Tumor filled pelvis and reached to umbilicus. *Macroscopic findings.* Uterus contains three tumors, the largest in anterior wall (almost entirely converted into a cyst); other two solid. Cyst-wall composed of sarcomatous elements; solid tumors sarcomatous. The large cystic growth was probably the primary tumor. *Microscopic findings.* Section shows typical peritheliomatous cells, irregular in shape and size, and of an active vegetative type; some with several nuclei, particularly those bordering upon the walls of the numerous capillaries. The young, round cells are clustered close to the endothelial lining of the capillaries—suggesting their origin either from the endothelial cells of the vascular lumen, or of the perivascular lymphatics. Hysterectomy. Recovery.

CASE 10. Reported by A. H. F. Barbour and B. P. Watson, J. Obst. & Gynæc., Brit. Emp., 1911, xx, 116. Patient aged 58. III-para. *Clinical history.* Menopause at 48. Ill for five months. Fetid, whitish leucorrhœa, later blood-stained, and watery. Tumor attached to uterus. Size of five months' pregnancy; firm; slightly tender; uterus freely movable; os patulous; tumor palpable within. *Macroscopic findings.* Uterus uniformly enlarged; no adhesions; irregular ovoid shape; six inches vertical diameter; 4 inches transverse. Tumor grows from fundus, upper two-third of anterior wall, and upper one-half of posterior wall. Lower pole projects free into uterine cavity. At fundus, muscular wall reduced to a mere shell. Section of tumor, yellowish-white, resembling brain-tissue in appearance and consistence. Throughout many hæmorrhages, most marked near fundus; in this region necrotic area. *Microscopic findings.* Section shows toward uterine wall, islands of tumor-cells consisting of a blood-vessel with intact endothelial coat, but the other coats replaced by radially arranged cells of irregular outline, each containing a large deeply, staining nucleus; most of cells lie at right angles to lumen of vessel. In some parts there are appearances suggestive of the origin of these cells from the lymph-channels, small spaces being visible, with the cells grouped around them. Hysterectomy. Recovery. No recurrence.

CASE 11. Reported by A. H. F. Barbour, J. Obst. & Gynæc., Brit. Emp., 1913, xxiv, 61. Patient aged 62. Single. *Clinical history.* At 56, large sloughing fibrous polyp, with a thick pedicle, projecting from vaginal orifice, removed. Well until 60; then began to fail. No pain. Gradually increasing abdominal swelling, till size of seven months' pregnancy. Cystic to feel. Uniform surface. *Macroscopic findings.* Tumor, 23 centimeters long, 14 centimeters wide, involving entire uterus; from its lower pole projects the cervix; bluish color; soft consistency; contains a large cystic cavity, over anterior wall of which stretches the uterine cavity, with its walls thinned out; length of uterine cavity, 19 centimeters. About the middle of the posterior cyst-wall is the remnant of a septum. Cyst-wall thin; lined with a layer of soft caseous matter, which at lower posterior portion of cyst projects as a growth into cyst-cavity. *Microscopic findings.* Cyst-walls show the structure of a uterine fibroid. Cavity lined with soft, yellowish-white necrotic tissue, which shows peritheliomatous change. Several small vessels lie in a loose cellular stroma; from their walls there is a definite cellular proliferation extending in the form of columns out into the stroma. Hysterectomy. Recovery.

CASE 12. Reported by W. F. Shaw, J. Obst. & Gynæc., Brit. Emp., 1913, xxiv, 221. Patient aged 46. Multipara. *Clinical history.* Menorrhagia and metrorrhagia for two years. At 44, fibromyomatous polyp, size of egg, protruding through cervix, removed. Two years later severe hæmorrhage. Another egg-sized polyp protruding from cervix. Patient anæmic. *Macroscopic findings.* Uterus but slightly enlarged. Polypus of a dark color, friable, size of small orange, springs from anterior wall of uterine cavity. *Microscopic findings.* Section of tumor shows it to be a fibromyoma extensively invaded with perithelioma, the large cells of which are collected radially round the blood-vessels. The uterine wall is not invaded. Vaginal hysterectomy. Recovery. No recurrence.

CASE 13. Reported by B. P. Watson, Am. J. Obst., 1914, lxix, 806. Patient aged 58. Primipara, thirteen years before. *Clinical history.* Menopause at 47. No bleeding until 57. Then watery discharge, occasionally streaked with blood, intermittent in character. Nine months later curetted. Scrapings showed malignancy. Two weeks later, operation. *Macroscopic findings.* Uterus 3 inches long, 2 inches wide; peritoneal surface normal. Along inner posterior wall is a small irregular projection on mucosa, 2 centimeters broad and 2 centimeters long. Rest of mucosa healthy. *Microscopic*

findings. Scrapings show large cells of epithelioid character, arranged in rows, and in one or two places arranged radially to a vessel-lumen. Section of tumor shows typical perithelioma; parts of growth necrotic, but greater part consists of masses of large cells arranged radially to lumina of blood-vessels. The growth is confined to the mucosa, in which small atrophied glands are visible. Base of growth infiltrates the superficial musculature. Here the cells form somewhat irregular columns and masses. Vaginal hysterectomy. Recovery. Subsequently developed squamous epithelioma of anterior vaginal wall near urethra, involving both sets of inguinal glands. Death.

CASE 14. Reported by F. W. N. Haultain, Tr. Obst. Soc., Edinb., 1914, xxxix, 133; also private communication. Patient aged 32. *Clinical history.* Much pain in back; slight menorrhagia. Ragged irregular condition of cervix, simulating carcinoma. *Macroscopic findings.* Uterus normal. Cervix shows growth involving cervical wall. *Microscopic findings.* Characteristic perithelioma. Vaginal hysterectomy. No recurrence.

CASE 15. Reported by F. W. N. Haultain, ibid. *Macroscopic findings.* Uterus seat of tumor involving corpus. *Microscopic findings.* Characteristic perithelioma. Hysterectomy. Recurrence in three or four months.

CASE 16. Reported by Mrs. F. E. Willey, Proc. Roy. Soc. Med., 1913, vii, Obst. and Gynec. Sect., 297. Patient aged 45. Single. *Clinical history.* For three years increasing menorrhagia. For six months recurring abdominal pain; no leucorrhœa. Uterus size of 3½ months' pregnancy; not tender. Appendages normal. Cervix healthy and nulliparous. *Macroscopic findings.* Uterus 4 inches long and 4 inches wide; outer surface normal. In posterior wall large solid tumor, 3 inches in diameter, projecting into cavity, fluctuating, of consistency of fat; white in color; degenerated in spots, resembling coagulated serum. Edge of growth not well defined from uterine tissue. Strands of fibrous tissue from capsule of uterine wall extend into tumor. Near the fundus the growth involves the uterine muscle. The endometrium is normal. *Microscopic findings.* Uterine wall invaded by masses of deeply stained tumor-cells; these resemble sarcomatous tissue; the cells are spindle-shaped, and are variously arranged. At places the entire tissue is composed of closely packed cells, with little intervening tissue; in other spots the cells are arranged in narrow channels, suggesting small empty capillaries; and in other places the growth has the structure of a perithelioma, being formed of thick-walled tubes with central lumina. Subtotal hysterectomy.

II. ENDOTHELIOMA

CASE 1. Reported by J. A. Amann, Jr., Inaugural Dissertation, Muenchen, 1892 p. 25. Patient aged 31. VI-para. *Clinical history.* For five years profuse yellowish white leucorrhœa. For two months pain in abdomen and back. No bleeding, save last period of fourteen days. *Macroscopic findings.* Tumor, size of hazelnut, on thickened posterior lip of cervix, consistence dense; surface gray, ragged. *Microscopic findings.* Tumor springs from deeper layer of cervical mucosa — from the endothelium of the lymph-vessels and lymph-channels. It consists of a connective-tissue stroma in which are numerous anastomosing cells, strands and masses, which contain central lumina. Removed by thermocautery. Recovery. No subsequent report.

CASE 2. Reported by J. McFarland, Med. News, 1894, lxv, p. 632. (From practice of Dr. C. P. Noble.) *Macroscopic findings.* Uterus shows a large, ragged, ulcerating fibroid tumor projecting from the upper posterior surface into the uterine cavity; circumscribed, with a broad pedicle almost continuous with the uterine wall. *Microscopic findings.* Tumor-substance unstriped muscle-tissue mixed with much fibrous connective tissue. Scattered throughout are occasional patches of uniform small round cells, irregularly arranged, but extending indefinitely into the surrounding lymph-channels. Some of the lymph-spaces are filled with proliferated cells, varying in size from that of a leucocyte to much larger, having two to five nuclei, and resembling epithelial cells at places. They contain degenerated protoplasm, hyaline in nature. Here and there are areas of necrosis. It is an endothelioma arising from the lymph-channels. Complete hysterectomy. Recovery. Six months later multiple recurrence in chest, breast, loin, thigh. Death.

CASE 3. Reported by H. B. Deale, Am. J. Obst., 1895, xxxi, 200. Patient aged 45. II-para. *Clinical history.* Menopause at 42. For over three weeks profuse watery discharge from uterus, blood-tinged for a week, slightly offensive. Uterus small, freely movable. Operation, September 13, 1894. *Macroscopic findings.* Uterus small. Small, circumscribed tumor in right cornu. *Microscopic findings.* Angiosarcoma of the endotheliomatous type. Vaginal hysterectomy. Recovery.

CASE 4. Reported by J. G. W. Rademacher, Inaugural Dissertation, Wuerzburg, 1895. Patient aged 43. *Clinical history.* Woman who died of mammary tumor. *Macroscopic findings.* On posterior lip of cervix a tumor the size of a walnut. *Microscopic findings.* Section shows growth springs from the endothelium of the lymph-channels.

CASE 5. Reported by L. Pick, Arch. f. Gynaek., 1895, xlix, 1. Patient aged 52. *Macroscopic findings.* Uterus shows submucous myoma; endometrium thickened below tumor. *Microscopic findings.* Section shows endothelioma originating in the lymph-capillaries. Hysterectomy.

CASE 6. Reported by A. Braetz, Arch. f. Gynaek., 1896, lii, 1. Patient aged 18. Nullipara. *Clinical history.* Periods irregular. Leucorrhœa for six months. Papillary tumor projecting from posterior cervical lip, 2 centimeters long, slightly bleeding, friable. Uterus not enlarged. *Macroscopic findings.* Uterus normal size. *Microscopic findings.* Section of tumor shows scanty connective-tissue stroma, with characteristic appearance of endothelioma — grouping of cells with central lumina. Blood-vessel walls normal. Endothelioma lymphaticum. Vaginal hysterectomy. Patient died in three or four weeks. Cause not given.

CASE 7. Reported by Grape, Inaugural Dissertation, Greifswald, 1897. Patient aged 54. *Clinical history.* Tumor projecting from vagina. *Macroscopic findings.* A metastatic growth from a primary uterine tumor. *Microscopic findings.* Section shows that tumor-cells had invaded the musculature. Characteristic endotheliomatous formation. Vaginal hysterectomy.

CASE 8. Reported by E. Hurdon, Bull. Johns Hopkins Hosp., 1898, ix, 186. Patient over 50. *Clinical history.* Menopause ten years ago. For eight years severe pain in pelvis, radiating to bladder. Slight hæmorrhage three weeks ago. Tumor on both cervical lips. *Macroscopic findings.* Uterus not enlarged. *Microscopic findings.* Section shows the tumor springs from the endothelium of the lymph-spaces. Hysterectomy. Death fourteen days later from sepsis.

CASE 9. Reported by P. Kroemer, Arch. f. Gynaek., 1902, lxv, 626. Patient aged 48. *Clinical history.* Had preclimacteric bleeding. Hard, friable tumor on posterior lip of portio. Operation in 1899. *Macroscopic findings.* Uterus uniformly enlarged. Tumor involves all the posterior cervix and extends through internal os into substance of corpus. The growth lies nearer the mucosa than the serosa. *Microscopic findings.* Mucosa of portio, cervix and corpus intact. Characteristic endotheliomatous ar-

rangement of cells in groups in the small lymph-vessels. Abdominovaginal total extirpation. Death on sixteenth day from peritonitis.

CASE 10. Reported by C. Gebhard, Ztschr. f. Geburtsh. u. Gynaek., 1902, xlviii, 111. Patient aged 42. Nullipara. *Clinical history.* For one year profuse bleeding. Tumor in left parametrium. Operation in 1899. *Macroscopic findings.* Tumor attached to the cervix. *Microscopic findings.* The tumor springs from the endothelium of the lymph-vessels — a typical endothelioma of the lymph-spaces. Hysterectomy.

CASE 11. Reported by H. Robb, Am. J. M. Sc., 1899, cxvii, 14. Patient aged 62. V-para. *Clinical history.* Puberty at 17. Menopause at 53. Three years later bloody vaginal discharge. For three weeks grinding pains in lower abdomen; pain in left leg; backache; constipated. *Examination.* Uterus anterior, enlarged, not freely movable. Operation — curettage. *Microscopic findings.* Scrapings show tumor-cells arranged in masses, at times solid, at times with central lumina. Cells oval, with large nuclei and nucleoli, and more or less chromatin-granules; between these intercellular substances faintly granular, and some small lymphoid cells. The tumor-cells ramify in the muscular stroma of the uterine wall. Cleft-like spaces in the rows of cells are lined with flattened endothelial cells. The cells fill the lymphatics, some of which are blocked, others showing central lumina. Tumor springs from the endothelium lining lymphatics in uterine wall. Endothelioma lymphangiomatodes. Uterine curettage; cervix cauterized. Recovery. Well one year later.

CASE 12. Reported by A. Pohorecký, Arch f. Gynaek., 1900, lx, 252. Patient aged 34. VIII-para; 2 abortions. *Clinical history.* For two years bloody flow; bleeding after coitus. Uterus enlarged. Tumor on posterior lip of cervix. *Macroscopic findings.* Uterus enlarged; on posterior cervical lip a smout-shaped tumor, size of plum; its surface slightly raw; consistence dense. *Microscopic findings.* Tumor-section shows alveolar structure; lymph-spaces of the fibrillar stroma enlarged and filled with tumor-cells. Endothelioma of the lymph-spaces. Vaginal hysterectomy. Recovery.

CASE 13. Reported by P. Kroemer, ibid. Patient aged 36. IV-para. *Clinical history.* Marked cachexia; profuse hæmorrhage. Uterus small, parametrium infiltrated. Ulcerated tumor on posterior lip of cervix. Operation in 1901. *Microscopic findings.* Vaginal epithelium of portio and that of cervix normally atrophic. Small-cell infiltration in deeper substance of cervix, beneath the epithelium. Characteristic endotheliomatous formation. Vaginal total extirpation.

CASE 14. Reported by P. N. Hansen, Virchow's Arch. f. path. Anat., etc., Berl., 1903, clxxi, 18. Patient aged 52. III-para. *Clinical history.* Puberty at twenty. For two years growth of lower abdomen; frequency of urination. Abdomen very large; œdema of legs. Operation, February 16, 1902. *Macroscopic findings.* Large tumor of uterus covered with serosa. Anastomosing vessels lying in a gelatinous mass. *Microscopic findings.* Tumor shows spots of necrosis. Proliferating endothelial cells in the lumina of the capillaries. Capillary endothelioma (hæmangio-endothelioma) of uterus. Supravaginal hysterectomy. Death in a few hours.

CASE 15. Reported by O. Silberberg, Arch f. Gynaek., 1902, lxvii, 469. Patient aged 64. Married. *Clinical history.* For some time profuse leucorrhœa; bloody for two days. Curetted and cauterized. Refused operation. *Macroscopic findings.* Uterus enlarged by tumor involving its entire substance. *Microscopic findings.* Scrapings dirty-gray color, show characteristic endothelial structure with alveolar meshes. Cellular proliferation in the lymph-vessels.

CASE 16. Reported by Rimann, Inaugural Dissertation, Breslau, 1902. Patient aged 48. VI-para. *Clinical history.* For three months profuse menstrual bleeding, every three weeks. On posterior lip of portio a tumor of the consistency of medulla. *Macroscopic findings.* Uterus enlarged, the tumor invading posterior wall. *Microscopic findings.* Section shows masses of small lymph-cells from the endothelium mixed with spindle cells of the wall. Proliferation of the endothelium of the veins. Abdominal total extirpation.

CASE 17. Reported by Rimann, ibid. Patient aged 36. V-para. *Clinical history.* For three months irregular bleeding. On portio, small cauliflower-like growth, easily bleeding; soft consistence. *Microscopic findings.* Section shows diffuse alveolar endothelioma springing from lymph-vessels. Vaginal total extirpation. Recovery.

CASE 18. Reported by O. von Franqué, Ztschr. f. Geburtsh. u. Gynaek., 1902, xlvii, 211. Patient aged 27. Married; nullipara. *Clinical history.* Puberty at 14. Menses irregular for past year. Last menses three months ago. Whitish leucorrhœa for six months. No pain; no bleeding. Cervical tumor. Excised and base cauterized. Ten days later operation. *Macroscopic findings.* A tumor projected from vulva; resembles placental tissue. It involves the portio and extends laterally into parametrium, especially on left side. Uterus 9.5 centimeters long, 4 wide, and 3 deep. *Microscopic findings.* Section of tumor shows characteristic endothelial tissue. Tumor springs from endothelium of the lymph-channels. Total vaginal hysterectomy, removal of adnexa. Recovery.

CASE 19. Reported by Papere, Arch. ital. d ginec., 1903, vi. VII-para. *Macroscopic findings.* An inoperable uterine tumor found in a dead woman. Uterus 7 centimeters long; cervix 13 centimeters long. Cervical mucosa healthy. A tumor in cervical tissue. *Microscopic findings.* Section of tumor shows an infiltration of connective tissue with large round cells, some cylindrical, some flat. Muscle-tissue degenerated. Marked proliferation of endothelium of the lymph-vessels—a true lymphangiosarcoma.

CASE 20. Reported by P. Kirchgessner, Ztschr. f. Geburtsh. u. Gynaek., 1903, xlix, 197. Patient aged 34. III-para. *Clinical history.* For 1½ years a yellow, bloody discharge. A walnut-sized polyp in upper vagina, springing from anterior cervical lip. Uterus not enlarged. *Macroscopic findings.* Uterus normal size. Tumor, size of walnut, in middle of anterior cervical lip. *Microscopic findings.* Section of tumor shows typical endotheliomatous formation, the growth springing from the walls of the lymph-capillaries—endothelioma lymphaticum. Total vaginal extirpation. Death in four days from septic peritonitis.

CASE 21. Reported by R. C. B. Maunsell, Brit. Gynæc. J., Lond., 1905, xxi, 177. Patient aged 40. V-para. *Clinical history.* Patient seen October 10, 1903. Progressive weakness; swelling of lower abdomen; fetid purulent discharge from a sinus one inch below umbilicus. Menstrual suppression from December 1902. Sinus opened in March, 1903. In August, 1903, bleeding for five days. Oval, firm, non-fluctuating tumor, reaching from pelvis to umbilicus, filling right iliac fossa and extending slightly to left of median line; dull percussion-note. Uterine cavity normal in size. Tumor adherent to or continuous with right cornu of uterus. *Macroscopic findings.* Cervix, uterine body, and left appendage normal. Right half of fundus and right cornu continuous with a globular tumor, 38 centimeters in vertical circumference, and 33 centimeters in transverse

circumference. Right tube springs from right side of tumor; is normal in length. Right round ligament springs from tumor, 5 centimeters below apparent origin of tube. Uterine cavity normal. Tumor enclosed in capsule of uterine tissue; lower portion an irregular, firm, myoma-like growth; upper portion a cystic cavity lined with a thin layer of same growth. *Microscopic findings.* Section of tumor shows a dense connective-tissue stroma containing alveoli of varying size, generally small. In these are masses of small cells with round nuclei, and a thin layer of protoplasm. The tumor resembles carcinoma, but the cells are smaller than cancer-cells. The cells in the alveoli are derived from the endothelium of the blood-vessels. In some places a connection can be traced between the normal endothelium of the vessels and the tumor-cells. The endothelial growth commences from the inner or endothelial lining of the blood-vessels. Endothelioma of uterine fundus. Supravaginal hysterectomy; both adnexa removed. Recovery. No recurrence.

CASE 22. Reported by Cova, Arch ital. di ginec., 1904, vii. Patient aged 35. Multipara. *Clinical history.* For six weeks bleeding. On the anterior cervical lip a bloody, mushroom-like growth, size of a nut. *Microscopic findings.* Section of tumor shows alevolar spaces filled with leucocytes and cubical and polyhedral endothelial cells. These cells have also proliferated into the musculature of the uterus. Vaginal hysterectomy. Recovery. No recurrence.

CASE 23. Reported by L. Federlin, Beitr. f. Geburtsh. u. Gynaek., 1904, viii, 190. Patient aged 52. Married; sterile. *Clinical history.* Menses passing off. Abdominal tumor reaching above the umbilicus. *Macroscopic findings.* Uterus normal in size; its musculature thick, and in its walls three tumor nodes—to the right, left, and in the posterior wall. Tumor of left ovary. *Microscopic findings.* Primary endothelioma of the ovary, with metastasis in the posterior uterine wall and in the right inguinal glands. Section of tumor shows alveolar structure with typical endotheliomatous formation. Total hysterectomy and removal of adnexa.

CASE 24. Reported by M. Graefe, Arch. f. Gynaek., 1904, xi, no. 72. Patient aged 30. I-para. *Clinical history.* Sanguinolent leucorrhœa with clots for some time. On portio vaginalis a cauliflower-like cancroid, the size of an apple. *Microscopic findings.* Section of tumor shows parallel and at places radiating masses of cells, with large, darkly-staining nuclei, of irregularly oval shape. The endothelium of the vessels is intact. Vaginal total extirpation. Death eight months later.

CASE 25. Reported by Marocco. Arch. ital. di ginec., 1904, v. *Microscopic findings.* Section shows the tumor to be a case of proliferating endothelioma.

CASE 26. Reported by H. Ravenna, Arch. de. méd. exper. et d'anat. path., 1905, xvii, 325. Patient aged 44. *Clinical history.* Patient died from an abdominal tumor which reached to the umbilicus. *Macroscopic findings.* Tumor firm; of a grayish-white color; lardaceous in appearance; of fibrous consistency. Growth has invaded omentum, peritoneum, uterus, parametrium, and lymph-glands in the prelumbar, mesenteric, and inguinal regions. It originated in the ovary. *Microscopic findings.* Section of tumor shows the characteristic endotheliomatous arrangement.

CASE 27. Reported by F. R. Zeit. J. Am. M Ass., 1906, xlvi, 567. (Practice of Dr. Emil Ries.) Patient aged 68. IV-para. *Clinical history.* Patient gave the clinical symptoms of uterine carcinoma. *Macroscopic findings.* Uterus normal in size, of a hard, fibroid consistency; 3 inches long, 1½ inches broad. Uterine cavity obliterated. Entire cervix and all corpus uteri (except the fundus) composed of a hard, tumor-like mass, of a white, scirrhous appearance. Cut surface smooth, white appearance with fine, irregular and round mosaic-like fields. The mucosa is smooth, atrophic, glistening. *Microscopic findings.* Section of the tumor shows a fibrillar ground-substance, with solid cellular cords, cut in longitudinal and transverse sections. Lymph-vessels and lymph-spaces lined with proliferating epithelioid cell-masses. These cords of cells appear like cellular cylinders of large diameter (lymph-vessel endothelioma), or as delicate cell-strips of two layers of flat cells branching here and there (lymph-space endothelioma). The larger endothelial cell-masses have numerous so-called lumina containing mucoid material. Other portions of the tumor look like scirrhous carcinoma. It is a lymphangio-endothelioma intravasculare of the uterus. Vaginal hysterectomy. Death in 11½ months from multiple metastatic tumors.

CASE 28. Reported by E. J. McWeeney and M. J. Gibson, J. of Path. & Bacteriol., 1907, xii, 132. Patient aged 50. Married; nullipara. *Clinical history.* Well until 48; then irregular uterine hemorrhages. Curetted, and a polyp removed. Hæmorrhage shortly recurred. Uterus size of two months' pregnancy; very hard; sensitive. Adnexa normal. Three months later curetted. Large succulent masses removed. *Macroscopic findings.* Uterus 4.5 inches long; 1.5 inches wide; wall uniformly thickened. Inner surface quite smooth. Embedded in wall two circumscribed nodules, size of hazelnuts, one 1 inch above upper end of cervix, the other 1 inch from fundus; both softer than surrounding tissue; lower one greenish tint on section. *Microscopic findings.* Lower nodule consists of an intimate admixture of sarcoma with cancer; large spindle cells mixed with irregularly-shaped cells; giant-cells; some with numerous nuclei. The carcinomatous portion consists of groups of large cells, clear, with large vesicular nuclei; cells round, square, and cylindrical. The groups in many places show central lumina, either empty or choked with débris of polynuclear leucocytes. Some of the lumina surrounded with but a single layer of cylindrical epithelium. Upper nodule composed of groups of large cells with or without lumina; they are embedded in a dense fibromuscular stroma. The endothelial cells lining the lymph-clefts in the uterine wall between the nodules are multiplied to produce rows of large cells, markedly hyperchromatic. Some proliferation of endothelium of the small blood-vessels. Combined sarcoma and endothelioma of uterine wall. Hysterectomy.

CASE 29. Reported by M. H. Phillips, J. Obst. & Gynaek., Brit. Emp., 1908, xiii, 103. Patient aged 50. Married; nullipara; widow fifteen years. *Clinical history.* For nine years increasing menorrhagia; severe hypogastric cramps; for fourteen months intermenstrual hæmorrhage. For several months offensive leucorrhœa. Backache. Loss of flesh and strength. Profuse purulent leucorrhœa, containing necrotic material. Uterus size of four months' pregnancy, but filled with a firm, rounded tumor, the size of a golf-ball, undergoing necrosis below. *Macroscopic findings.* Uterus 12¾ centimeters long, 7½ wide, and 7 anteroposteriorly; anterior wall greatly thickened by the new-growth, which almost obliterates upper part of uterine cavity. Upper part of tumor gray color, with reddish-brown areas of hæmorrhage; friable, deeply fissured, presenting a necrotic, ragged surface to the uterine cavity. Lower portion ovoid in shape; yellowish-white; of firm consistence, with a smooth, round surface. *Microscopic findings.* Tumor largely composed of irregular masses of cells lying between the muscular and fibrous bundles. The cells are mainly polyhedral in shape, but there are also numerous rounded and spindle-shaped cells. All have well-defined nuclei, moderately rich in chromatin, and

with nucleoli. The cell-masses are carcinomatous in type. They are closely packed in irregular spaces, which sometimes show a flattened endothelial lining. In these irregular spaces (lymphatics) there is no intercellular material, and at places there is a distinct proliferation of the endothelial lining. At places the cells are arranged in a concentric fashion round both large and small blood-vessels. The tumor has arisen from an abnormal proliferation of the endothelial cells lining the lymph-spaces, many of which, are filled with the tumor-cells. There is an associated glandular carcinoma of the endometrium. Abdominal hysterectomy. Death four weeks later of phlegmasia alba dolens and septic thrombosis of left pulmonary artery.

CASE 30. Reported by F. Curtis and J. Vanverts, Écho méd. du Nord, 1913, xvii, 380. Patient aged 56. V-para. *Clinical history.* Leucorrhœa for a number of years. For eighteen months chocolate-colored discharge from vagina, fetid. Menorrhagia and metrorrhagia. Pain in lower abdomen. Hard mass felt above pubes and filling Douglas' cul-de-sac. *Macroscopic findings.* Uterus size of cocoanut, with irregular bosselated surface, of a reddish-yellow color. Section friable, tissue resembling sarcoma; involves entire uterus. *Microscopic findings.* Sections show uterine tissue completely invaded by tumor-cells, which fill the lymph-spaces; they spring from the endothelium lining the lymph-vessels. Supravaginal hysterectomy. Death on fifth day.

CASE 31. Reported by G. Sell, Ztschr. f. Krebsforsch., 1914, xiv, 26. Patient aged 19. Married; nullipara. *Clinical history.* Puberty at 14; menses irregular; for three months every three days heavy bleeding. Uterus of normal size; parametrium infiltrated. *Macroscopic findings.* Uterus shows a cervical tumor, especially involving the anterior lip, but not invading the corpus. *Microscopic findings.* Section shows that the tumor springs from the endothelium of the lymph-vessels, and gives the characteristic endotheliomatous features. There is a round-cell infiltration of the parametrium. Total extirpation of uterus, with adnexa. Recovery.

BIBLIOGRAPHY

1. ACKERMANN. Die Histogenese und Histologie der Sarkome. Volkmann's Samml. klin. Vortr., 1882, Nos. 233 and 234, 1971.
2. ALEZAIS and PEYRON. Un groupe nouveau de tumeurs épithéliales: les paragangliomes. Compt. rend. Soc. de biol., Par., 1908, Dec. 15, 745.
3. IDEM. Sur les caractères cytologiques de la cellule chromaffine dans les paragangliomes-surrenaux. Ibid, 1910, July 12, 206.
4. AMANN, J. A., JR. Ueber Neubildungen den cervical Portion des Uterus. Inaugural Dissertation, Muenchen, 1892, p. 25.
5. IDEM. Ueber Ovarialsarkome. Arch. f. Gynaek., 1894, xlvi, 484.
6. APELT, F. Ueber die Endotheliome des Ovariums. Hegar's Beitr. z. Geburtsh. u. Gynaek., 1901, v, 367.
7. BACQUÉ, B. J. I. B. Les tumeurs périthéliales. Bordeaux, 1912, No. 137.
8. BARBOUR, A. H. F. Endothelioma ovarii. Scott. M. & S. J., 1895, Dec., ref. Zentralbl. f. Gynaek., 1906, xxx, 1244.
9. IDEM. Two cases of uterine fibroid in which degeneration in the tumor—perithelioma and necrobiosis—caused difficulty in diagnosis. J. Obst. & Gynæc., Brit. Emp., 1913, xxiv, 61; Tr. Edinb. Obst. Soc., 1912, xxxviii, 202.
10. BARBOUR, A. H. F., and WATSON, B. P. Two cases of perithelioma: (1) Of the uterus; (2) Of the tube. J. Obst. & Gynæc., Brit. Emp., 1911, xx, 116.
11. BAYON, P. G. E. On peritheliomata and endotheliomata and their position in oncology. Brit. M. J., 1907, ii, 1400.
12. BECKTON, H. A note on the formation of certain types of endothelioma. Arch. Middlesex Hosp., London, 1910, xix, 195.
13. BELLATI. Sugli endoteliomi dell'ovaio. Policlinico, 1895, sec. chir., ii, 164.
14. BENDER, X., and PROUST, R. Périthéliome de l'ovaire. Bull. et mém. Soc. anat., Par., 1909, July, 455.
15. BOLAFFI, A. Particolare forma di sarcomatosi. Patologica, Genova, 1912, v, 635.
16. BOLL, F. Beitraege zur mikroskipischen Anatomie der acinoesen Drusen. These de doct., Berl., 1869.
17. BOERMANN, R. Zum Wachstum und zur Nomenclatur der Blutgefaessgeschwulste. Arch. f. path. Anat. u. Physiol., 1899, clvii, 297.
18. IDEM. Endotheliom. Ergebnisse von Lubarsch u. Ostertag, 1900, 7th year, p. 870.
19. BORST, M. Das Verhalten der Endothelien bei der akuten und chronischen entzuendung. Verhandl d. phys.-med. Gesellsch. zu Wuerzb., 1897.
20. IDEM. Die Lehre von den Geschwuelsten. Wiesbaden: 1902, i, 294.
21. BRAETZ, A. Ein fall von Endetholiom der Portio vaginalis. Arch. f. Gynaek., 1896, lii, 1.
22. BROUHA. Contribution a l'étude des endothéliomes de l'ovaire. Rev. de gynèc. et chir., abd., 1900, iv, 435.
23. BRUCKNER, J. De l'endothéliome de l'ovaire. Rev. de gynèc. et chir. abd., 1901, v, 459.
24. BURCKHARD, G. Ueber cystische Eierstockstumoren endothelialer Natur. Ztschr. f. Geburtsh. u. Gynaek., 1899, xl, 253.
25. CARL, W. Endotheliale Ovarialtumoren. Arch. f. Gynaek., 1909, lxxxix, 608.
26. CARLESS, A. Some recent reports concerning endotheliomata and peritheliomata. Practitioner, Lond., 1906, lxxvi, 228.
27. COURTAULD. The phylogenetic origin of endothelial cells. Arch. Middlesex Hosp., London, 1906, ix.
28. COVA. Endothelioma del collo dell'utero. Boll. d. Soc. Ass. ost. et ginec., 1902, December.
29. Idem. Gli endoteliomi dell'utero. Arch. ital. di ginec., Napoli, 1904, 7th year.
30. CURTIS, F., and VANVERTS, J. Endothéliome (d'origine lymphatique) de l'uterus, ayant entrainé la bascule complète de l'organs. Écho méd. du Nord, Lille, 1913, xvii, 380.
31. DEALE, H. B. Sarcoma fundi uteri. Am. J. Obst., N. Y., 1895, xxxi, 200.
32. DORAN, A. H. G., and LOCKYER, C. Two cases of uterine fibroids, showing peritheliomatous changes. Proc. Roy. Soc. Med., 1908, ii, Obst. and Gyn. Sect., p. 25; J. Obst. & Gynæc., Brit. Emp., 1908, xiv, 320; Brit. M. J., 1908, ii, 1543.
33. DORLAND, W. A. N. Perithelial sarcoma of the uterus. J. Am. M. Ass., 1908, li, 1227.
34. DRIESSEN, L. F. Untersuchungen ueber glykogenreiche Endotheliome. Beitr. z. path. Anat. u. allg. Path., 1893, xiii, 65.
35. EBERTH, C. J. Ueber die Blut- und Lymphgefaesse des Gehirns und Rueckenmarks. Arch. f. path. Anat. u. Physiol., 1870, xlix, 481.
36. EBNER, VON. Untersuchungen ueber den Bau der Samenkanaelchen. Leipzig: 1871.

37. Eckardt, T. Ueber endotheliale Eierstockstumoren. Ztschr. f. Geburtsh. u. Gynaek., 1889, xvi, 344.
38. Ewing, J. An intra-uterine perithelioma. Proc. N. Y. Path. Soc., 1908, viii, 85.
39. Eymer, H. Beitrag zur Lehre von den Lymphangiendotheliomen des Eierstockes. Arch. f. Gynaek., 1909, lxxxviii, 189.
40. Federlin, L. Ein Fall von Endothelioma ovarii (Haemangioendotheliom) mit Metastasen in Lymphdruesen und Uterus. Beitr. f. Geburtsh. u. Gynaek., 1904, viii, 190.
41. Ferroni, E. Sul miofibroendothelioma dell'utero. Ann. di ost., 1901, xxiii, 115, 250, 382, 500, 633.
42. Fick, J. Ueber die Unbrauchbarkeit der Arbeitshypothese Endotheliom. Dermat. Wchnschr., Leipzig and Hamburg, 1912, liv, 488.
43. Flaischlen. Zur Pathologie des Ovariums. Ztsch. f. Geburtsh. u. Gynaek., vii, 434.
44. Fraenkel, von. Endothelioma ovarii. Monatschr. f. Geburtsh. u. Gynaek., 1898, vii, 253.
45. Franqué, O. von. Carcino-sarko-endothelioma tubæ. Ztsch. f. Geburtsh. u. Gynaek., 1902, xlvii, 211.
46. Frattin. Beitrag zur histologischen Kenntniss der Endotheliome der Blutgefasse. Arch. f. d. Sc. méd., 1902, Zentralbl. f. Allg. Path. 1902, xiii.
47. Frommel, R. Das Oberflaechenpapillom des Eierstocks, etc. Ztsch. f. Geburtsh. u. Gynaek., 1890, 44.
48. Fueth, H. Ueber eine angeborene Geschwulstbildung perithelialen Natur. Beitr. z. Geburtsh. u. Gynaek., 1902, p. 82.
49. Fullerton, W. B. Uterine sarcoma. Surg., Gynec. & Obst., 1914, xix, 771.
50. Gallina, J. Ein Fall multiplen Endotheliom. Virchow's Arch. f. path. Anat., etc., Berl., 1903, clxxii, 290.
51. Gebhard, C. Eine Mischgeschwulst der Uterus (Endotheliom mit Fett- und Knorpelgewebe). Ztsch. f. Geburtsh. u. Gynaek., 1902, xlviii, 111.
52. Geist, S. H. A contribution to the histogenesis of sarcomatous change in uterine fibromyomata. Am. J. Obst., 1913, lxviii, 1053.
53. Glockner, A. Ueber das Vorkommen von ein — und mehrkernigen Riesenzellen und Riesenzellen mit Riesenkernen in Endothelialen Geschwuelsten. Zeigler's Beitr. z. path. Anat. u. z. allg. Path., Jena, 1899, xxvi, 73.
54. Godart. Endothéliome des deux ovaires, etc. Mouvement hyg. Bruxelles, 1903, p. 169.
55. Góth, L. Bedrohliche innere Blutung aus einem Perithelioma ovarii. Ztschr. f. Geburtsh. u. Gynaek., 1908, lxii, 26.
56. Graefe, M. Zwei Faelle von Endobeziehungsweise Perithelioma ovarii und ein Fall von Endothelioma der Portio vaginalis. Arch. f. Gynaek., 1904, xi, No. 72.
57. Grape. Ein Fall von Endosarkom des Uterus. Inaugural Dissertation, Greifswald, 1897.
58. Guffroy. Endothelioma ovarii. Inaugural Dissertation, Freiberg, 1897.
59. Haacke. Ueber Geschwulstbildungen endothelialen Ursprungs in einem Ovarial Kystom. Inaugural Dissertation, Halle, 1901.
60. Hansemann, D. von. Ueber Endotheliome. Deutsche med. Wchnschr., 1896, xxii, 52.
61. Idem. Die mikroskopische Diagnose der boesartigen Geschwuelste. Berlin: 1902, 2d ed., p. 69.
62. Hansen, P. N. Haemangiendothelioma intravasculare uteri. Virchow's Arch. f. path. Anat., etc., Berl., 1903, clxxi, 18.
63. Haultain, F. W. N. Endothelioma of the cervix of the uterus. Tr. Obst. Soc. Edinb., 1914, xxxix, 133.
64. Heinleth, von. Beitrag zur Histologie der Perithelioma der Glandulæ carotideæ. Zentralbl f. allg. Path. u. Path. Anat., 1900, xi, 599.
65. Heinricius, G. Ein Fall von Endothelioma lymphaticum ovarii. Arch. f. Gynaek., 1904, lxxiii, 323.
66. Henle, J. Handbuch der systematischen Anatomie der Menschen, t. H. Eingeweidelehre. Brunswick: 1866.
67. Herz, M. Zur Kenntniss des Endothelioma ovarii. Monatschr. f. Geburtsh. u. Gynaek., 1899, ix, 458.
68. Hildebrand. Ueber Resektion der Penis wegen eines Endothelioma intravasculare. Deutsche Ztsch. f. Chir., 1898, xlviii, 209.
69. Hinsberg, V. Beitraege zur Entwickelungsgeschichte und Natur der Mundspeicheldruesengeschwuelste. Deutsche Ztschr. f. Chir. 1899, li, 281.
70. His, W. Arch. f. mikr. Anat., 1865, i.
71. Idem. Ztschr. f. wissensch. Zool., xv, 127.
72. Idem. Die anatomische Nomenklatur, 1895.
73. Huizinga. Endothelioma portionis vaginalis uteri intravasculare. Nederl. Tijdschr. v. Geneesk., 1902, xiii.
74. Hume, W. E. Endotheliomata. Univ. Durham Coll. M. Gaz., Newcastle, 1904, v, 85.
75. Hurdon, E. Endolioma of the cervix uteri. Bull. Johns Hopkins Hosp., 1898, ix, 186.
76. Jones, Mary Dixon. A hitherto undescribed disease of the ovary; endothelioma changing to angioma and hæmatoma. N. Y. M. J., 1889, 1, 337.
77. Karsner, H. T. A case of primary endothelioma of the omentum. J. Am. M. Ass., 1911, lvi, 1871.
78. Kermanner, F. Lymphangiom der Tube. Arch. f. Gynaek., 1907, lxxxiii, 411.
79. Kirchgessner, P. Ueber Endothelioma cervicis uteri. Ztschr. f. Geburtsh. u. Gynaek., 1903, xlix, 197.
80. Kirchner, A. Boesartiges Endotheliom. Deutsche mil.-aerztl. Ztschr., Berl., 1905, xxxiv, 16.
81. Klein. Epithel, Endothel und Carcinom. Festschr. z. Feier der 50th jaehrigen Jubilaums der Gesellschaft f. Geburtsh. u. Gynaek., 1894.
82. Kolliker, R. von. Handbuch der Gewebelehre der Menschen, 1857, p. 495.
83. Kotschau. Ueber Endothelioma ovarii. Zentralbl. f. Gynaek., 1896, xx, 1118.
84. Kolaczek, J. Ueber das Angiosarcom. Deutsche Ztschr. f. Chir., 1878, ix, 1, 165.
85. Kretschmar. Endothelioma ovarii cysticum. Verhandl. d. IX, Gynaek., Cong., 1901.
86. Kroemer, P. Klinische und anatomische Untersuchungen ueber den Gebaermutterkrebs. Arch. f. Gynaek., 1902, lxv, 626.
87. Krompecher, E. Der druesenartige Oberflaechenkrebs — Carcinoma Epithelial eadenoiedes. Ziegler's Beitrage z. path. Anat., u. z. allg. Path., Jena, xxviii, 1.
88. Idem. Ueber die Geschwuelste, insbesondere die Endotheliome des Hodens. Virchow's Arch. f. path. Anat., etc., Berl., 1898, cli.
89. Idem. Ueber Vinbindungen, Uebergaenge und Umwandlungen zwischen Epithel, Endothel und Bindegewebe bei Embryonen. Beitr. z. path. Anat. u. allg. Path., 1904, xxxvii, 28.

90. KRUKENBERG. Ueber das Fibrosarcoma ovarii mucocellulare Carcinomatodes. Arch. f. Gynaek., 1896, l, 287.
91. Idem. Beitrag zur Kenntniss des Perithelioma ovarii. Ztschr. f. Geburtsh. u. Gynaek., 1899, xli, 473.
92. KUBO, T. Ueber das Lymphangiendothelioma ovarii. Arch. f. Gynaek., 1909, lxxxvii, 664.
93. KWOROSTANSKY, P. Endotheliom des Ovariums und der Tube. Arch. f. Gynaek., 1908, lxxxv, 355.
94. LANGE, VON, M. Ein fall von Endothelioma ovarii. Zentralbl. f. Gynaek., 1903, xxvii, 65.
95. LANGER, A. Ueber einen Fall von Sarcoma ovarii. Arch. f. Gynaek., 1895, xlix, 508.
96. LAZARUS-BARLOW, W. S. The histological diagnosis of the endotheliomata. Arch. Middlesex Hosp., Lond., 1906, vii, 79; Glasgow M. J., 1907, lxvii, 265.
97. Idem. The relations of endothelioma to other forms of new-growths. Proc. Roy., Soc. Med., London, 1907, Path. Sect., p. 167.
98. LEITH, R. F. C. The pathology of tumors of the corpus uteri. J. Obst. & Gynæc., Brit. Emp., 1911, xix, 447; Birmingham Med. Rev., 1910, xix, 181, 253.
99. LEOPOLD, G. Die Lymphgefaesse des normalen, nicht schwangeren, Uterus. Arch. f. Gynaek., 1873, vi, 1.
100. Idem. Die soliden Eierstocksgeschwuelste. Arch. f. Gynaek, 1873, vi, 189.
101. Idem. Ueber Sarcoma uteri. Arch. f. Gynaek., 1873, vi, 493.
102. LEYDIG, F. Lehrbuch der Histologie der Menschen und der Thiere. Frankfort am Main: 1857, p. 495.
103. LIGABUE, P. Beitrag zum Studium der Eierstocksendotheliome. Arch. f. Gynaek., 1910, lxi, 160.
104. LIMACHER. Ueber Blutgefaessen endotheliome der Struma. Virchow's Arch., f. path. Anat., etc., Berl., 1898, cli.
105. LINCK, A. Ein Fall von Endothelioma lymphaticum kystomatosum beiden ovarien. Inaugural Dissertation, Koenigsberg, 1900.
106. LINCOLN, W. Endothelioma of the ovary. Cleveland M. J., 1903, ii, 29.
107. LUBARSCH, O. Endotheliom. Ergebn. v. Lubarsch u. Ostertag, ii, 1895, p. 592.
108. LUPPOFF, A. Endothelioma of the body of the uterus. J. akush. i jensk. boliez., St. Petersb., 1907, xxi, 1290.
109. MACNAUGHTON-JONES. Discussion. Brit. Gynæc. J., May, 1906, xxii, 36.
110. MCFARLAND, J. A large round-cell sarcoma of the uterus. Med. News, 1894, lxv, 632.
111. M'WEENEY, E. J., and GIBSON, M. J. Sarcoma and endothelioma in the same uterus. J. Path. & Bacteriol., Cambridge, 1907, xii, 132.
112. MALLORY, F. B. The histological classification of tumors. Boston. M. &. S. J., 1909, clxi, 137.
113. MARCHAND. Beitrag zur Kenntniss der Ovarialtumoren. Abhandl. der Naturf. Gesellsch., 1879, xiv; Habititationsschrift, Halle: 1879.
114. MAROCCO. Contributo allo studio dell'endotelioma della cervice uterina ed al conteguo dell'endotelio dei vasi inaltre forme uterine. Arch. ital. di ginec., 1904, v.
115. MAUNSELL, R. C. B. Endothelioma of the uterus. Brit. Gynæc. J., Lond, 1905, xxi, 177; Med. Press & Circ., Lond., 1905, lxxx, 83.
116. MAURER. Ueber einem eigentuemlichen Fall von Angiosarkom. Inaugural Dissertation, Halle, 1883.
117. MENETRIER. Discussion sur le périthélioma. Bull. de l'Ass. franç., pur l'étude du cancer, 1911, January 16, 36.
118. MENGE. Ueber Zwei Faelle von Myosarcoma uteri lymphangiectaticum. Zentralbl. f. Gynaek., 1895, xix, 453.
119. MEYER, R. Ueber Druesen, Zysten und Adenome im Myometrium bei Erwachsenen. Ztschr. f. Geburtsh. u. Gynaek., 1900, xliii, 130–168.
120. Idem. Das Endotheliom des Uterus. Veit's Handb. d. Gynaek., 1908, iii.
121. MIRABEAU, S. Perithelioma ovarii cysticum. Monatschr. f. Geburtsh. u. Gynaek., 1899, x, 462.
122. MOENCKEBERG, J. G. Endotheliom. Ergebn. v. Lubarsch. u. Ostertag., 1904, x, 730.
123. MUELLER, V. Ueber Carcinom und Endotheliom des Eierstocks. Arch. f. Gynaek., 1892, xlii, 387.
124. NADAL, M. P. Encore de périthéliome; tumeurs périthéliales ou aspects périthéliaux? Bull. ass. franç., étude du cancer, 1911, March 20, 156.
125. NEWMANN, S. Dermoidcyste eines Eierstockes mit mal Degeneration, etc. Arch. f. Gynaek., 1899, lviii, 185.
126. PALAZZO, G. Contributo alla conoscenza del peritelioma. Clin chir., Milano, 1909, xvii, 781.
127. PALTAUF, R. Ueber Geschwuelste der Glandula carotica. Beitr. z. path. Anat. u. allg. Path., 1892, xi, 260.
128. PAPAÏOANNOU, T. L. Zur Kenntniss der Endothelialen und metastatischen Ovarialtumoren. Monatschr. f. Geburtsh. u. Gynaek., 1904, xx, 802.
129. PAPERE. Sull'endotelioma dell'utero. Note anatomo-patologit. Arch. ital. di ginec., Napoli, 1903.
130. Idem. Ancora sull'endotelioma dell'utero. Clin. mod., Firenze, 1903, No. 50.
131. PERTHES, G. Ueber verkalkte Endothelioma im Unterhautbindegewebe. Beitr. z. klin. Chir., 1894, xii.
132. PFANNENSTIEL, H. J. Das traubige Sarkom der Cervix uteri. Virchow's Arch. f. path. Anat., etc., Berl., 1892, cxxvii, 305.
133. PHILLIPS, M. H. A case of endothelioma of the uterus arising in a fibromyoma and associated with glandular carcinoma of the endometrium. J. Obst. & Gynæc., Brit. Emp., 1908, xiii, 103.
134. PICK, L. Die von dem Endothelien ausgehenden Geschwueltze des Eierstocks. Berl. klin. Wchnschr. 1894, Nos. 45 and 46, p. 1017.
135. Idem. Zur. Lehre vom Myoma sarcomatosum und ueber sogenannte Endotheliome der Gebaermutter. Arch. f. Gynaek., 1895, xlix, 1.
136. PIERRE-NADAL. Encore le périthéliome. Tumerus périthéliales ou aspect périthéliaux. Bull. assoc. franç. étude du cancer, Paris, 1911, iv, p. 156.
137. POHORECKY, A. Die endothelgeschwuelste der Uterus. Arch. f. Gynaek., 1900, lx, 252.
138. POLANO, O. Ueber Pseudoendotheliome des Eierstocks. Ztschr. f. Geburtsh. u. Gynaek., 1904, li, 1.
139. POLLAK, E. Zur Kenntniss des Perithelioma ovarii. Monatschr., f. Geburtsh. u. Gynaek., 1898, vii, 179.
140. POMORSKI, J. Endothelioma ovarii. Ztschr. f. Geburtsh. u. Gynaek., 1890, xviii, 92.
141. PROCOPIO. Contributo anatomo-patologico e clinico allo studio degli endotheliomi dell'ovaio. Arch. di ost. e. ginec., 1908, June.
142. RADEMACHER, J. G. W. Ein Fall von Endothelioma cervicis uteri. Inaugural Dissertation, Wuerzburg, 1895.

143. RASCHKES, H. Beitrag zur Kasuistik der primaeren Vaginaltumoren. Zentralbl. f. allg. Path. u. path. Anat., 1903, xiv, 657.
144. RAVENNA, H. Observationes anatemo-pathologiques et critiques sur les tumeurs endothéliales. Arch. de med. exper. et d'anat. path., Par., 1905, xvii, 325.
145. Idem. Alcune considerazioni sui tumori endoteliale. Path. riv. quindicin., Genova, 1908, i, 264.
146. RECLUS, P., and CHEVASSU, M. Les tumeurs du corpuscule retro-carotidien. Rev. de chir., 1903, Aug. and Sept., 149, 338.
147. RENAUT, J. Traité d'histologie pratique, Paris, 1893, p. 799.
148. RIBBERT, H. Lehrbuch der pathologischen Histologie, 1901.
149. Idem. Das endotheliom. Lehrbuch der allg. Path., Leipzig, 1901, p. 593.
150. Idem. Geschwulstlehre, Bonn, 1904, p. 589.
151. RIMANN. Die Endotheliome des Uterovaginalschlauches Erwachsener. Inaugural Dissertation, Breslau, 1902, No. 2.
152. ROBB, H. A case of endothelioma lymphangiomatodes of the cervix uteri. Am. J. M. Sc., 1899, cxvii, 14.
153. ROSENBACH, F. Zur Kasuistik der Endotheliome. Charité-Ann., Berl., 1906, xxx, 496.
154. ROSINSKI, B. VON. Zur Lehre von den endothelialen ovarial geschwuelsten, Ztschr. f. Geburtsh. u. Gynaek., 1896, xxxv, 215.
155. ROSTHORN, A. VON. Zur Kenntniss des Endothelioma ovarii. Arch. f. Gynaek., 1891, xli, 328.
156. ROUSSY, G., and AMEUILLE, P. A propos du périthéliome. Aspect périthéliaux dans les tumeurs épithéliales. Bull. soc. franç. étude du cancer, Par., Atti d. Cong. internaz, d. patol., 1911, Torino, 1912, i, 20.
157. Idem. A propos du périthéliome; revue critique des faits publiés. Bull. assoc. franç. étude du cancer, 1911, March 20, p. 143.
158. Idem. Le périthéliome. La Semaine méd., 1911, xxvi, 385.
159. SCHARLIEB, MARY. Case of perithelioma of the uterus. Med. Press & Circ., Lond., 1906, lxxxi, 335; Brit. Gynæc. J., Lond., xxii, 36.
160. SCHENK, F., and SITZENFREY, A. Gleichzeitiges Karzinom des Magens, der Ovarien und des Uterus mit besonderer Beruecksichtigung, ihrer operativen Behandlung und der histologischen Befunde. Ztschr. f. Geburtsh. u. Gynaek., 1907, lx, 302.
161. SCHLAGENHAUFER, F. Ueber das metastatische Ovarialcarcinom nach Krebs des Magens, etc. Monatschr. f. Geburtsh. u. Gynaek., xv, 485.
162. SCHMIDLECHNER, C. Perithelioma labii maioris. Arch. f. Gynaek., 1905, lxxiv, 195.
163. SCHUERMANN, E. Ein Fall von Endothelioma ovaricum lymphaticum cysticum. Ztschr. f. Geburtsh. u. Gynaek., 1903, No. 50, 233.
164. SCHWERTASSEK, F. Sarcomatoese Degeneration einer mit einem Teratom combinirten Ovariencyste. Arch. f. Gynaek., 1894, xlvii, 568.
165. SELL, G. Ein Fall von endotheliom des Uterus (Lymphangioendotheliom). Ztschr. f. Krebsforsch., Berlin, 1914, xiv, 26, 38.
166. SERTOLI, E. Ueber die struktur des Steissdruese der Menschen. Arch. f. path. Anat. u. Physiol., 1868, xlii, 370.
167. SHAW, W. FLETCHER. Perithelioma of the uterus. J. Obst. & Gynæc., Brit. Emp., 1913, xxiv, 221.
168. SILBERBERG, O. Ein Fall von Endothelioma uteri. Casuistische Mittheilung. Arch. f. Gynaek., 1902, lxvii, 67, 469.
169. SMITH, G. F. D. Some notes on a case of perithelioma of the endometrium. J. Obst. & Gynæc., Brit. Emp., 1908, xiv, 331; Tr. Obst. Soc., Lond., 1907, xlix, 97.
170. SOUBEYRAN, P. Endothéliome de l'ovaire. Bull. et mém. Soc. anat., Par., 1902, No. 7. p. 639.
171. SPERBER, A. Zur Kasuistik der sogenannten Uterus endotheliome nebst kritischen Bemerkungen ueber die anatomische Diagnose derselben. Dissertation, Leipzig, 1903.
172. SSOBOLEW, L. W. Zur Lehre den endothelialen Neubildungen. Virchow's Arch. f. path. Anat., etc., Berl., 1900, clxi, 56.
173. STAUDER, A. Ueber Sarkome des Ovariums. Ztschr. f. Geburtsh. u. Gynaek., 1902, xlvii, 357.
174. STEFFECK, P. Zur Entstehung der epithelialen Eierstocksgeschwuelste. Ztschr. f. Geburtsh. u. Gynaek., 1890, xix, 236.
175. STEINHAUS, J. Perithelioma (angiosarcoma peritheliale) ovarii. Zentralbl. f. allg. Path. u. path. Anat., 1900, xi, 817.
176. STOLZ, A. K. Ein Beitrag zur Lehre vom Endotheliom des Uterus. Gynaek. Rundschau., 1910, iv, 813.
177. SVOBODA. Ein Fall von Endotheliom der Portio vaginalis. Leipzig: 1903.
178. SZERSZYNSKI, B. Zkazuistyki seródblonicków (endothelioma). Przegl. chir. i. ginek., Warszawa, 1913, viii, 209.
179. TANAKA, M. Ueber die klinische Diagnose von Endotheliomen und ihre eigentuemliche metastasenbildung. Deutsche Ztschr. f. Chir., 1899, li, 209.
180. TIMOFEYEFF, A. Endothelioma of the uterus combined with fibromyoma (adenomyoma). J. akush. i jensk. boliez., St. Petersb., 1911, xxvi, 954.
181. TROVATI, G. Contributo allo studio dell'endotelioma ovaio. Ann. di ost. e. ginec., 1898, xx, 201.
182. TUSINI. Sopra alcune varieta di endoteliomi. Pisa, 1898.
183. TWEEDY, E. H. Report of the Rotunda Hospital, Dublin, for the year ending Oct. 31, 1906. Tr. Roy. Acad. Med., Ireland, 1907, xxv, 317.
184. UFFREDUZI. Un caso di perithelioma dell'ovaio (Hæmangiosarcoma peritheliale ovarii). Ginecologia, xii, 223; Frommel's Jahresb., 1905, p. 452.
185. VELITS, D. VON. Endothelioma cysticum myxomatodes ovarii. Ztschr. f. Geburts. u. Gynaek, 1890, xviii, 106.
186. VIGNARD, P., and MOURIQUARD, P. Du périthéliome. Rev. de Chir., 1905, xxxii, 467.
187. VIRCHOW, R. Die Krankhaftigen Geschwuelste. 1862, iii, p. 201.
188. VOGL, F. Ein Eall von Endothelioma lymphaticum. Dissertation, Muenchen, 1895.
189. VOIGT, M. Zur Kenntniss des Endothelioma ovarii. Arch. f. Gynaek., 1894, xlvii, 560; ibid, 1895, xlix, 43.
190. VOLKMANN, R. Ueber endothelialen Geschwuelste. Deutsche Ztschr. f. Chir., 1895, xli, 1.
191. Idem. Ueber die Bezeichnung Endotheliom. Deutsche med. Wchnschr., 1896, xxii, 223.
192. WALDEYER. Die epithelialen Eierstocksgeschwuelste, etc. Arch. f. Gynaek., 1870, i, 252.
193. WATSON, B. P. Perithelioma of the uterus. Am. J. Obst., 1914, lxix, 806.
194. WIEDERSHEIM. Ueber einen Fall von Endothelioma ovarii. Inaugural Dissertation, Freiberg, 1900.

195. WILLEY, MRS. F. E. Endothelioma of the uterus. Proc. Roy. Soc. Med., Lond., 1913, vii, Obst. & Gynec. Sect., p. 297.
196. WILMS. Die Mischgeschwuelste. Ergebn. v. Lubarsch u. Ostèrtag, 1900–1901, 870.
197. ZANGEMEISTER, W. Ueber Sarkome der Ovariums. Inaugurai Dissertation, Heidelberg, 1896, Beitr. z. klin Chir., xvi, No. 2.
198. ZEIT, F. R. Morphologic and histogenetic characteristics of endothelial tumors. J. Am. M. Ass., 1906, xlvi, p. 567.
199. ZEMBRZUSKI, L. Perithelioma. Now. lek., Poznan, 1913, xxv, 8.
200. ZEITZSCHMANN. Beitrag zur Kenntniss der Peritheliome angiosarcome bei Thieren. Ztschr. f. Thier. med., 1904, viii, 417.

HÆMANGIOMA CAVERNOSUM

REPORT OF A CASE

BY WILLIAM E. LOWER, M.D., F.A.C.S., CLEVELAND, OHIO

CLASSIFICATION AND ETIOLOGY

IF one may judge from the literature published under the general head of *hæmangioma*, there is considerable confusion concerning the real nature of this condition. In the reported cases, for example, there are several instances in which tumors classified as hæmangiomata, apparently were really either angiomata or nevi. Nicholls classifies as hæmangiomata those tumors "consisting of arteries, capillaries, and veins, which are supported and held together by connective tissue or by tissues homologous with it, such as adipose and mucoid tissue." In his differentiation of all hæmangiomata into three groups, simple, arteriole and cavernosum, he includes in the latter class those in which there are large vascular spaces or sinuses lined with endothelium. With its reticular blood spaces, the hæmangioma cavernosum is similar in structure to the corpus cavernosum of the penis. The irregular spaces are filled with blood, they communicate with each other, and they are surrounded with a retiform fibrous tissue, which also contains elastic fibers, the network varying in thickness in different parts of the tumor. The mass is fed by a single artery and discharges its blood into the dilated veins.

A hæmangioma cavernosum is evidently the result of some anomaly in development, the exact nature of which is unknown. Nicholls finds this growth in situations corresponding to the embryonic lines of fusion, such as the facial or branchial clefts. Kirmisson defines the usual positions of hæmangioma cavernosum as the anterior and lateral parts of the neck where it often extends along the whole of the neck from jaw to clavicle,

Fig. 1. Case of hæmangioma cavernosum in baby four months old showing size and location of the tumor.

Fig. 2. Case of hæmangioma cavernosum showing roentgenogram of cyst.

Fig. 3. Case of hæmangioma cavernosum, showing result after excision; also the line of incision.

or it may be limited to one part, as to the submaxillary or the supraclavicular fossa. It may extend from the very front to the back of the neck, or from the base of the skull to the clavicle. In fact, cases are recorded in which the tumor has passed under the clavicle and has extended into the axilla, and others in which it has invaded the mediastinum after passing behind the sternum. Whatever its situation, this growth has a tendency to adhere closely to the sheath of the great vessels, especially to the jugular vein.

In Lexer-Bevan it is stated that hæmangioma cavernosum is partly expansive and partly infiltrating in character; it may be slow and continuous in growth or it may increase rapidly after a stationary period. Not infrequently an encapsulated hæmangioma is found which has ceased to grow. In most cases, however, the mass gradually infiltrates the neighboring tissues, including both the cellular spaces and the muscles themselves. After thrombosis and cicatricial contraction of parts of the tumor, the involution may be complete.

DIAGNOSIS

The peculiar color and form of this variety of hæmangioma practically assures the diagnosis. Another distinguishing characteristic is the fact that the cyst may be decreased by pressure, immediately assuming its original size and form when the pressure is removed. The tumor is bluish in color, and increases in size when the patient coughs or cries. It is encapsulated and palpable, and since it is fed by a large artery, it pulsates. Morris thinks all cavernous hæmangiomata are present at birth, though they often are not noticed immediately.

TREATMENT

The usual treatment of a hæmangioma cavernosum is its complete extirpation, although Carl Beck has devised an ingenious method by which the masses of vessels are gradually transformed into connective tissue by a subcutaneous spiral ligature. "In this manner the circulation is shut off within the tumor. . . . This procedure is repeated until the tumor has been diminished to the smallest possible nodule of connective tissue, and the healthy skin enlarged to the utmost. Then the hard connective masses are excised and the borders united in fine linear union. . . . It is necessary to ligate the largest afferent vessels."

CLINICAL HISTORY OF CASE

The appearance and treatment of a typical case of hæmangioma cavernosum is well illustrated by the following history of a case of my own:

The patient, a baby of four months, was referred to me by Dr. Schmoldt, and on January 2, 1916, was sent to Lakeside Hospital. The father was living and well at 56, the patient being the only child of a second marriage. The mother had a history of "kidney trouble" and pain in the back, but no dyspnœa or swelling of the feet. The family history was negative for malignancy or heart disease.

The patient, a full-term baby, was bottle fed, and had never been sick. Soon after birth the mother noticed a small lump about the size of a walnut just above the clavicle on the right side of the neck. This mass was quite soft and was the color of the surrounding tissue. Palpation was not painful. The tumor gradually increased in size until the child was three months of age, when it began to assume a bluish tinge. Whenever the baby cried, the mass appeared to increase in size, but there was no accompanying pain. At the time the case first came under my observation, the mass had reached the size of a

Fig. 4. Case of hæmangioma cavernosum, showing size and shape of mass after excision.

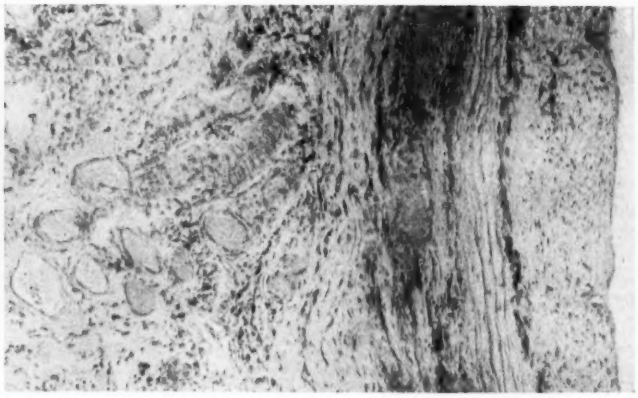


Fig. 5. Case of hæmangioma cavernosum, showing section through wall.

large lemon and occupied an area on the right side of the neck, extending from beneath the scapula and clavicle almost up to the ear (Fig. 1). It was bluish in color, and increased in size when the baby cried or was held up by its feet. On palpation it was found to be soft, cystic, and seemed multilocular in character. Light did not penetrate the mass. On continued gentle pressure it decreased slightly in size and some pain was caused. The skin was freely movable over the tumor which was somewhat adherent to the underlying tissue, no definite pedicle being discovered. The roentgenogram showed a very definite outline of the tumor (Fig. 2).

Under nitrous oxid and oxygen anæsthesia, an incision was made around the base of the tumor, with the idea that if complete removal became too hazardous it might still be possible to ligate or compress the vessels supplying it. By sharp dissection I was able to cut around the growth and finally to remove it intact. The cyst was in close proximity to the large vessels of the neck, extended behind and below the clavicle, was in direct contact with the pleura, its tip being behind the scapula. The blood supply apparently came from a branch of the subclavian artery. Hæmostasis was secured by fine silk ligatures and the wound was closed with continuous sutures of No. 16 silk. The dressings were put on very loosely, so as not to interfere by pressure with the circulation in the flap. There was an immediate sharp rise in temperature, but the patient made a complete and rapid recovery.

The pathological examination confirmed our diagnosis of hæmangioma cavernosum. The tumor weighed 155 grams and measured 9x6x4.5 centimeters (Fig. 4). It was coarsely lobulated, reddish purple in color, and fluctuant. The surface was covered by numerous small fat tabs. The mass was soft, cystic, thin-walled, and was apparently divided into numerous small and large communicating cavities. The contents of the mass consisted of 100 cubic centimeters of thin, brownish chocolate colored fluid and some old broken down blood-clots. The inner lining was smooth, glistening, and membranous. In some of the smaller spaces there were present organizing blood-clots adherent to the wall. The smaller and larger spaces were often connected by fine cord-like structures resembling chordi tendoni. No very large or definite blood-vessels were found entering or emerging from any of the spaces.

A microscopic examination of a section through the wall (Fig. 5) showed a fibrous tissue framework in which were numerous, fairly large, thin-walled, endothelial lined spaces filled with blood. Many of the vessels had well-defined coats while others were simple spaces lined with endothelium. There was considerable lymphocytic and eosinophilic infiltration, chiefly around these blood-vessels. There was also considerable coarse brownish pigment scattered about, chiefly intracellular. The walls of the large spaces consisted of a thick fibrous inner coat lined by endothelium in places, and of an outer muscular coat. The histological appearance was that of greatly distended veins having well defined fibrous and muscular coats. The lesion was comparable with cystic hygroma, the blood-vessels instead of the lymphatic system being involved in this case. The diagnosis of the pathologist was congenital blood-cyst or cavernous hæmangioma.

REFERENCES

Beck. J. Am. M. Ass., 1903, xli, 1575.

Howard. Practice of Surgery, 1914, p. 332.

Kirmisson. Handbook of Surgery of Children, 1910, p. 76 (English Edition).

Kramer. Jahrb. f. Kinderh., 1904, xi, 297.

Lexer-Bevan. General Surgery, 1908, p. 825.

Morris. Charlotte, N. C., M. J., 1912, lxvi, 76.

Nicholls. American Practice of Surgery (Bryant and Buck), 1906, i, 320.

Patton. Northwest Med., 1913, n. s., v, 119.

AN OPERATION FOR THE RELIEF OF EPISPADIAS IN THE MALE[1]

By J. DELLINGER BARNEY, M.D., F.A.C.S., Boston

In view of the well known difficulties encountered in dealing with epispadias in the male, I wish to describe an operation for its relief which we have found to be simple and efficient.

There are certain definite indications for operation: (1) to relieve urinary incontinence; (2) to change the point of exit and the direction of the urinary stream and of the semen; (3) to change the direction and length of the penis; (4) to restore the penis to a more normal appearance.

As a result of the more or less complete urinary incontinence and of the point of exit of the urine at the base of the penis, the skin of the suprapubic region is constantly macerated, inflamed, and at times ulcerated. The position of the penis in relation to the abdominal wall is such that the stream of urine is directed almost vertically upward, acting as a sort of spray against the pubes.

Furthermore, the direction and small size of the penis make coitus difficult or impossible, while the point of exit of the semen at the penopubic junction makes impregnation highly improbable. The restoration of the penis to as nearly normal a direction as possible is, therefore, much to be desired, while an improvement in the appearance of the organ does much to eliminate that sense of shame and sensitiveness which so often harasses the victim of a malformation of the genitals.

Although a simple plastic operation, such as is here described, cannot be expected to do away with urinary incontinence entirely, marked improvement often takes place, a feature already noted by Stettiner[2] in an extensive survey of the literature. In babies and young children, even when normal, there is little or no volition in the control of the vesical sphincter. But as the child grows older, control is gradually gained, and can often be developed to a remarkable degree by a system of muscle training aimed directly at the sphincter. I have used this successfully for a number of years in the care of the bladder in tabetics[3] but it must be

[2] Ergebn. d. Chir. u. Orth., 1913, v.

[3] Boston M. & S. J., 1910, Dec. 22, 29; 1911, Jan. 5.

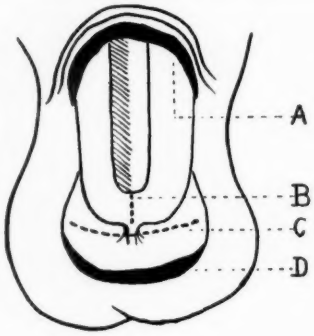


Fig. 1.

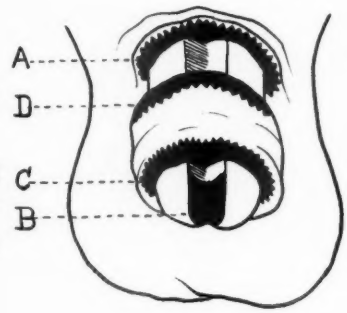


Fig. 2.

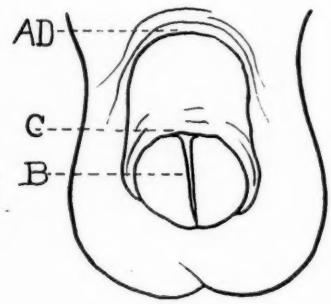


Fig. 3.

Fig. 1. Diagram of penis. *A*, Refreshed edge of pubic skin fold; *B*, line of incision through glans to prolong urethral gutter to its end; *C*, button-hole incision through prepuce; *D*, refreshed edge of prepuce for suture to *A*.

Fig. 2. Diagram of plastic operation. *A*, as in Fig. 1, ready to be sutured to *D*, Fig. 1. The inner or mucous layers (straight edges) are approximated one to the other, after which the outer layers (serrated edges) are united. The outer (serrated edge) layer of the button-hole incision *C*, Fig. 1, is then sutured to the inner or mucous layer (straight edge). *B* is the newly-formed portion of the urethra.

Fig. 3. Diagram of penis after operation, showing lines of suture at *A*, *D* and *C*. The entire urethra is now roofed over except the short portion formed at *B*, at which point the urine now makes its escape.

[1] From the Genito-Urinary Department of the Massachusetts General Hospital.

Fig. 4. Epispadias in profile before operation, showing the almost vertical direction of the penis, its short length, and its voluminous prepuce.

Fig. 5. Epispadias before operation. Penis drawn down to show extent and position of urethral gutter. The dermatitis of the pubes is also shown.

remembered that in epispadias one is dealing with an imperfectly developed sphincter muscle.

None the less such training is to be regarded as a highly essential post-operative measure, and if the patient is old enough and intelligent enough to co-operate, there is every prospect of success. It is also important that the patient should be kept under fairly regular observation. The vesical sphincter must be not only brought to, but maintained at, the highest possible point of efficiency and this can be accomplished only by constant attention.

The technique of the operation is as follows:

1. The urethral gutter, already formed, is carried out to the very end of the glands by dividing this structure longitudinally and to the proper depth as shown by the dotted line *B*, Fig. 1. In order to prevent its edges from again uniting, the groove is kept constantly lined with gauze, or, better, with rubber tissue, until the mucosa has covered the raw surfaces.

2. The prepuce, always voluminous (seen in profile in Fig. 4), is used to form a roof over the urethral gutter. To this end a transverse button-hole incision (*C*, Fig. 1) is made through it, just below the frenum and extending laterally nearly to its edges. At the same time the lower edge of the prepuce is denuded by the removal of the narrow strip of skin (*D*, Fig. 1), and a similar procedure is carried out on the fold of pubic skin which roofs the urethra at the root of the penis (*A*, Fig. 1).

3. The glans is then drawn through the button-hole slit in the prepuce so that the denuded lower edge of the latter now comes well up on the penile shaft (*D*, Fig. 2). It will also result that the glans is completely surrounded by the edges of the button-hole incision (*C*, Fig. 2). The newly-formed portion of the urethra is indicated at *B*, Fig. 2.

4. The plastic is now completed by suture of the cut edges. *A* (Fig. 2) is approximated to *D* (Fig. 2), the inner layers (represented by a straight line) being united one to the other with No. ∞ chromic catgut, the outer layers (represented by serrated edges) being united in the same manner, but with fine silk or Pagenstecker linen. The unusual redundancy of the prepuce allows this union to be made without tension. The edges of the button-hole (*C*, Fig. 2) are then sutured to one another (straight edge to serrated edge in the diagram) with silk or Pagenstecker linen.

The completed sutures have the appearance and position indicated in the diagram (Fig. 3, *AD* and *C*), while the new portion of the urethra, the new meatus, is seen at *B*. The rest of the urethra is completely roofed by the plastic flap, which can be readily retracted, like a normal prepuce.

The more or less vertical position assumed by the penis in epispadias is to be attributed to its unusually short suspensory ligament. While in my experience the plastic operation already described has been sufficient to restore

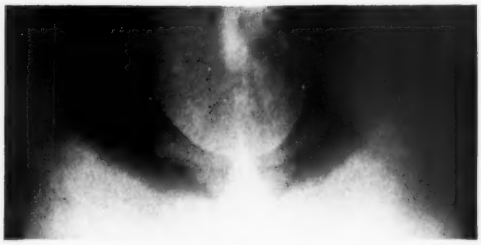


Fig. 6. Roentgenogram of the symphysis showing separation of the pubic bones.

the penis to an essentially normal position, other writers (Duplay, Stettiner) have spoken of the desirability of cross-cutting the suspensory ligament and suturing it longitudinally to accomplish this purpose.

While the entire operation can be done at one sitting it has seemed desirable to do Part I as a preliminary step, allowing two or three weeks to elapse before performing the more extensive plastic operation. This will allow the newly formed portion of the urethra to become thoroughly covered with mucosa. Furthermore, every chance should be given the wounds to heal *per primam*. The bladder should, therefore, be constantly drained by an in-lying catheter, of the self-retaining type, or, in the opinion of some surgeons, by a catheter brought out through a small perineal incision. The latter method, however, has the objection that in order to do this the corpora cavernosa, which, in epispadias, underlie the corpus spongiosum and the urethra, must be separated or incised in their perineal portion, a procedure which is not easy to accomplish and which may be accompanied by considerable bleeding.

Yet in spite of every care, it seems to be the general experience, as it has been mine, that the plastic flaps will fail to unite at one or more points. These fistulæ are a source of annoyance, but can be easily closed by suture at a subsequent time.

In adults the entire operation can be done with novocaine anæsthesia; in infants and young children full ether anæsthesia must be given.

The following case illustrates well the essential points of epispadias and of the operation described.

Fig. 7. Appearance of the penis three years after operation. The prepuce can be easily and completely retracted, and the direction of the penis is normal.

A. F., age 15, entered hospital February 14, 1913. Family history: no other congenital defects. Past history, unimportant. Present illness: Malformation of penis, with urinary incontinence since birth. The patient wets the bed almost every night and his clothes are wet all day. Sometimes he is aware that urine is escaping, but usually not. At times he goes for two hours without urinating. During erection the penis is held close to the abdominal wall. He has never attempted coitus.

Physical examination shows a well-developed, healthy looking, intelligent boy, with no demonstrable abnormalities, congenital or acquired, except of the penis. Both testes are normal in size, consistency, and sensation, and are fully descended. There is a typical and complete epispadias, but the malformation cannot be fully appreciated until the penis is drawn down by its prepuce (Fig. 5). The nearly vertical position assumed by the penis, its small size, and its voluminous and apron-like prepuce has already been shown in Fig. 4. A roentgenogram of the symphysis (Fig. 6) shows a very considerable separation of the pubic bones (a constant feature of all such cases). The pubic skin is red, thickened, and covered with pustules (Fig. 5). The stream of urine forms a sort of spray

against the pubes, but when the penis is pulled downward the stream can be fairly well directed into a basin. When the boy coughs or makes any muscular effort which fixes the diaphragm, urine is seen to gush from the urethra. Urine normal. Training of the vesical sphincter started, and continued daily with good response.

February 21. Can hold urine for four hours. Condition of pubic skin is greatly improved since it has been kept dry. Under ether the urethral gutter was extended to the end of the glans by a longitudinal incision (*B*, Figs. 1 and 2). The edges of the wound were separated by a strip of rubber tissue. Self-retaining catheter to bladder was kept in place for 5 days. March 2. Training of sphincter has been continued. The patient can now hold urine in the day several hours and often passes nearly a pint at a time. He keeps dry all night by being aroused once or twice to urinate. March 3. Under ether a plastic was done on the prepuce (Figs. 1, 2, and 3), and a self-retaining catheter inserted. There was good union of the skin edges, except for a small area at junction of *A* and *D*, through which urine leaks. March 13. Discharged, but is to return for closure of the fistula.

October 20, 1913. Re-entry. There is no frequency of urination. He has good control day and night. The penis hangs in a nearly normal direction. The urethra now runs to the end of the glans and the newly formed part is lined with mucosa. The pubic skin is healthy. October 21.—Under ether, the small fistula in plastic was closed by suture. Self-retaining catheter inserted. October 30. Discharged. To return for observation.

August, 1914, seen in Out-Patient Department. His condition is greatly improved. The preputial flap now covers the entire urethra except at its distal extremity. There are no fistulæ. A stream of urine issues from the end of the penis so that the patient can stand at a urinal without wetting his clothes. He says he does not leak day or night, and can retain urine for several hours. Urine normal.

November, 1914, the patient writes that he has no trouble with urination.

January 1, 1916. Patient was seen at hospital. His general condition is good. Urinates 5 or 6 times a day, gets up sometimes once at night. There is considerable incontinence by day, but never wets bed at night. He passes a good stream and directs it well. Sex function evidently normal, but has no emissions and has not attempted coitus. Plastic looks well and prepuce covers nearly whole of glans. Rectal examination shows prostate small but normal in contour. Vesicles not felt.

The patient has had no training in the control of the sphincter since he left the hospital. From my experience in this case and in others I do not hesitate to say that if exercises for the education of the sphincter could be undertaken with fair regularity and frequency, the diurnal incontinence of which the patient now complains could be greatly improved or even entirely done away with.

ECTOPIA TESTIS TRANSVERSA WITH INFANTILE UTERUS

By ARTHUR E. HERTZLER, M.D., Kansas City, Missouri

THE condition in which both testes find their way into one scrotal pouch was designated by v. Lenhossak as "ectopia testis transversa." But one testis of course is ectopic. The other one undergoes a normal descent and is accompanied by its fellow which, instead of descending into its own side, crosses over to the opposite side and accompanies or follows its normal fellow.

The cause of this transposition is found in some early developmental disturbance. The nature and cause of this disturbance furnishes the most interesting problem in this lesion. Though rare, some 13 cases having been described, enough data is available not only to make possible some conclusions relative to the clinical treatment of this condition, but presents data of importance in the whole problem of developmental anomalies of the genito-urinary system.

The specimen which I have to report made its appearance in the literature in 1907. Dr. Halstead[1] at that time operated on the patient for hernia and noted the testicular transposition. He reported it and presented some comments on the origin of this condition. His report is as follows:

D. C. B., American, single, age 42, entered the Cook County Hospital in January, 1904.

History. Patient has had a left inguinal hernia of large size since early childhood. Of late this hernia has increased in size until now the tumor measures eight inches from the pubic spine to

[1] Surg., Gynec. and Obst., 1907, iv, 129.

Fig. 1. Below are the testes showing the coverings deflected to the right. Above the testes is the infantile uterus on either side of which are the epidimides.

the lower limits of the scrotum. Two months ago the hernia, which had previously been reducible, became irreducible and painful. In addition to the hernia he has for several years been suffering from severe hæmorrhoidal disease. His object in entering the hospital was to secure by operative treatment relief from both diseases.

Examination. On entrance, examination showed a well developed middle aged man. Nothing worthy of note was found, except a large left inguinal hernia, distending the scrotum to the size of a child's head. Rectal examination disclosed the presence of a large mass of ulcerating hæmorrhoids protruding from the anus.

Operation. In clinic, January 7, 1904, assisted by Dr. R. H. Rea, house surgeon. After the usual preparation, an incision 3½ inches long was made over the hernia, exposing the sac. The sac was opened and the adherent loops of small intestine constituting the contents of the hernial sac, were, after being freed, returned to the abdominal cavity. In separating the sac it was noted that the spermatic cord was of unusual size. While freeing the sac from the cord the remaining contents of the left side of the scrotum were brought into the incision. This was found to be the structure which in superficial examination closely resembled a uterus with the tubes and ovaries attached. Upon closer inspection it was found that the central body, representing the uterus, consisted of a fusion of the epididymides of the two testicles. The testicles were not closely adherent to the heads of the fused epididymides, but swung free from the attached lower half of each with the entire mass dislocated forward into the operative wound. The fused heads of the epididymides occupied a position behind and somewhat below the testicles. The testicles were inclosed in a common tunica vaginalis. The vasa defferentia could be traced separately from the globus minor upward behind the fused epididymides to a short distance above the globus major where they approached each other and apparently became fused into one cord close to the internal ring. There were two spermatic arteries and two sets of veins; these were of large size and, with the large vasa defferentia and usual amount of fatty tissue, greatly increased the size of the cord. The testicles were small and in size were decidedly out of proportion to the large mass representing the fused epididymides.

Examination showed the right side of the scrotum to be empty. The right external ring was closed.

This patient re-entered medical records by consulting Dr. A. E. Spalding of Luverne, Minnesota, November 1, 1913. The following is abstracted from Dr. Spalding's report.

At that time the patient presented an enlarged scrotum containing several ounces of fluid which was removed by a needle. He again presented himself for examination on October 26, 1914. At this time the scrotum was as large as two fists and was causing much pain. On October 29, 1914, the scrotal contents were removed. The mass was exposed through a long inguinoscrotal incision, the cord isolated and tied. This being done a second cord, larger than the first, was exposed. This part of the cord cut like cartilage and showed a dense-walled tube leading to the tissue between the two testicles. When the mass was severed a coffee-colored fluid escaped.

The specimen was sent to Dr. L. W. Littig of Davenport, Iowa. It was through the kindness of Dr. Littig that I was enabled to study the specimen.

The specimen presents a bifid mass surrounded by a thick capsule and terminates above in a long pedunculated process. The lower portion of the mass is made up of two lobules which are testiculiform, slightly smaller than a normal testicle and when arranged parallel with each other and with the central axis of the mass they are easily recognized as testicles. Situated posterior to these bodies are corrugated tubules inclosed in a fibrous sheath, free below but united above. These are readily recognized as epididymides after the fibrous tissue

is dissected off. Leading from the upper poles of these are wound cords, obviously vasa defferentia. These pass upward over an elongated pyriform mass. This mass is unattached to either epididymis or testis.

This body forms the most interesting feature of the specimen. It begins just above the upper poles of the testes as an elongated pyriform body, 2 centimeters in its transverse diameter and 1 centimeter in its anteroposterior diameter. It gradually narrows to 6 millimeters at its termination where it is tubular (Fig. 1). Its termination shows that it was severed during the operation and that the entire specimen was not obtained. When opened in a longitudinal direction it shows a triangular lumen 1 centimeter wide below, gradually narrowing above. The anteroposterior diameter is only a millimeter or two. The cavity is lined by a smooth mucous membrane. The cut surface of the wall of this mass is a uniformly deep red in color.

The walls of this body are formed of non-striated muscle-fibers. The lining is a mucous membrane made up of a low columnar epithelium with simple tubular glands lined with cuboidal or low columnar cells. In short the structure is that of an elongated infantile uterus.

The testicles and appendages present an entirely normal structure.

The interest in this specimen lies less in the transposition of the testis, rare as this condition is, than in the presence of the small uterus, a condition noted in the literature in but one other instance; Case 7 reported below.

Various theories of the origin of this condition have been advanced and these are presented in conjunction with the case reports.

The following brief abstracts represent all the cases that I have been able to collect from the literature. In some of the cases reported a careful dissection of the parts was not made and therefore a detailed description of the condition could not be given.

CASE 1. Reported by v. Lenhossak.[1] This specimen was removed at autopsy by the author's father in 1845. The patient was a man of 35. Both testicles were of normal size and contour and both lay in the bottom of the scrotum on the left side, the right, however, being 2.5 centimeters higher than the left. The vasa were differentiated a few centimeters from their origin but approached each other and became so closely bound together by connective tissue that one might have thought that they were one. Thus bound together they passed through the inguinal canal to the abdomen and at the upper end of the prostate they again became divided, the left entering a normal seminal vesicle on the left side, the right going by a sharp angle to the right to enter a normal seminal vesicle on the right side.

The author suggests that this condition was probably due to either a faulty development of the right testicle on the left side, or to the action of certain forces which carried it to the opposite side. In favor of the view that the testicle developed on the wrong side are the various examples of a similar condition in the kidney. A double kidney with two ureters has been reported by Stocquart.[2] This is an example of the transposition of an antimere.

CASE 2. Reported by Jordan.[3]

Patient, age 8, had hypospadia in the third degree. The right side of the scrotum was small, being marked only by a small prominence. The left side was about the size of a goose egg. Upon opening the processus vaginalis at operation two testicle-like bodies were noted in the scrotum from which two cords extended to the rings. Three months later the hernia recurred and a new hernia operation was performed, the total contents of the scrotum being removed. There was a single vas for both testicles which was large and out of proportion to the age of the patient. The thickness of its walls increased from above downward and below it ended in an ampulla which was broad, particularly in its transverse diameter. The vasa arose from the corners of this and the epididymis was much enlarged and fibrous. The right vas was normal in size and led to the bursa inguinalis to a lobule of fat. This vas had no epididymis, but some epididymal canals were present instead of the epididymis. No testicle was present on this side.

The cause of this condition is to be found in an early fusion of the wolffian ducts in that part lying nearest to the sinus urogenitalis, while that portion lying nearest to the testicle remained free. They fused abnormally in the same manner that the muellerian ducts normally do. The thought must be entertained, however, that well-developed muellerian ducts may have played a rôle. These changes certainly take place before the descensus. (Examined by Klaatsch.)

CASE 3. Reported by Linser.[4]

Patient a boy age 2½ years. Both testicles lay in a serous cyst in a right-sided inguinal hernia. The testicles lay side by side, were of equal size, and the epididymides were well formed. The vasa were separated and found to extend to the base of the bladder but they could not be traced with certainty to the seminal vesicles.

The author believes that there was a double anlage on the right side and that the left had either atrophied or an anlage had never formed.

CASE 4. Reported by Christopherson.[5]

Patient, age 22, came to the hospital with a swelling in the right inguinal region, extending from the external abdominal ring into the scrotum.

[1] Anat. Anz., Jena, 1886, i, 376.

[2] Virchow's Arch. f. path. Anat., etc., Berl., 1879, lxxviii, 244.

[3] Deutsch. med. Wchnschr., 1895, xxi, 525.

[4] Beitr. z. klin. Chir., 1900, xxix, 381.

[5] Brit. M. J., 1903, i, 312.

Upon opening the right inguinal canal a jelly-like mass was found extending through the canal and into the scrotum. This mass was about the thickness of three fingers and unencapsulated. There were two spermatic cords coming through this same canal, one of which, traced downwards, ended in the epididymis of the descended and very much enlarged testicle. The other cord ended in frayed-out ends which were lost in the embryonic jelly-like tissue at the top of the scrotum. This cord lay to the inner side and behind the other cord; both cords felt and looked natural and were easily separable from each other. There was no cavity in the left side of the scrotum nor was there any sign of a descended processus vaginalis.

The author thinks that the fully developed and descended testicle was the left because the prostate was well developed on the left side but seemed absent on the right.

CASE 5. Reported by Berg.[1]

Patient, age 13, had had a left-sided rupture since birth. The right side of the scrotum was poorly developed and there was a large scrotal hernia on the left side. At the bottom of the left half of the scrotum was a fair-sized testicle, its free concave border pointing downward. From its right pole a normal-sized cord passed upward to near the root of the penis, then curved sharply to the left and was lost near the opening of the hernial ring. When the patient coughed slightly a smaller testicle could be felt at the left external ring, which could be pulled down into the scrotum. A cord passed from it into the hernial ring. The right external ring was very small and no cord could be felt to enter it. At operation both testicles and cords were found to be intimately connected with the hernial sac on the left side. Both cords passed through the left inguinal canal. The upper testicle was the smaller and its cord had a distinct mesentery. This cord passed up into the left inguinal canal, through the internal ring, across the space of Retzius to the right inguinal region where it descended to the pelvis. The larger testicle lay in the bottom of the sac; its cord passed up into the left inguinal canal and descended on the left side of the bladder to the pelvis. The right internal ring was exposed and found to be closed. The scrotum showed no evidence of division into two compartments. Both cords and testicles were treated as one and the radical hernia operation completed in the usual manner.

CASE 6. Reported by Romanowski and Winiwarter.[2]

Patient, age 61 died of pneumonia. On section there was noted a fold which extended from the fovea inguinalis lateralis across the anterior wall of the pelvis, behind the upper surface of the bladder, to the left of the fovea inguinalis lateralis where it disappeared. The plica differentialis was absent on the right side but was well developed on the left. The right side of the scrotum was empty. The external ring on this side was very small and out of it came a small connective-tissue band which ended like a ligamentum teres. On the left side the external ring was much enlarged and the cord thickened. Upon opening the sac two testicles were noted, the right situated slightly above the left which was small and deformed. The right was larger and less deformed but had the epididymis on its summit, from the center of which the vas arose. The processus vaginalis was open to near the external ring but from this point on it was completely obliterated. The left vas run its normal course to the base of the bladder and into the seminal vesicle. The right vas, however, traversed the bladder obliquely over to the right side, its course corresponding to the plica differentialis already noted. The right spermatic vessels arose at the normal place and described a normal course to the linea terminalis, from which point they followed the previously described peritoneal fold from right to left to the left ring. A gubernaculum Hunteri could be traced from the external ring through the canal and across the summit of the bladder in company with the vessels.

The author thinks that there must have been some abnormal connection between the two testicles which made it possible for the left to take the right with it in its descent.

CASE 7. Reported by Cornil and Brossard.[3]

Patient, age 19, had a uterus in the tunica vaginalis which was united with two testicles. This uterus measured 9.5 centimeters in length, the body being larger than the cervix and the walls somewhat thickened. On one side the tube emerged normally but became adherent at its extremity to the testicle. On the other side the cornu of the uterus was united to the testicle by a fibrous mass. On section of the uterus the walls were found to be thick, the mucosa congested and presented transverse plications separated by ridges 2 millimeters in diameter.

Histological examination. (1) Uterus. On section it was found that the transverse plications represented numerous glands and tubes lined by a tall epithelium. Between the depressions the mucosa was thicker, rich in small cells and contained fewer glands. Toward the body cavity the mucosa was more papillary. These papules were formed by inflammatory tissue with hypertrophied glands lined with tall epithelium. (2) Testicles. Sections made at the point where the tube attached showed a normal tube and epididymis united by connective tissue. The testicles were normal and spermatogenesis very active. The fibrous band going out from the opposite cornu showed likewise a tube and epididymis united by fibrous tissue. There was not the vestige of an ovary. Section of a cornu showed a tube in its interstitial tissue.

This condition was due to a diversion in development, consisting of an increased development of the uterus due to the fusion of the muellerian ducts.

[1] Ann. Surg., Phila., 1904, xl, 223.

[2] Anat. Anz., Jena, 1905, xxvi, 635.

[3] Bull. Acad. de med., Par. 1907, 3rd s., lviii, 246.

The wolffian and muellerian ducts must have developed side by side because they were united by a common connective-tissue envelope.

CASE 8. Reported by de Castelli.[1]

Patient, age 23, came into the hospital to be operated on for a right-sided hernia. The hernia was congenital, and had gradually increased in size and become very painful. The left side of the scrotum was found to be empty. The right side contained two testicle-like bodies which were painful on pressure. From these came two cords which disappeared into the inguinal ring. At operation the cord was exposed accompanied by the artery and veins. Within the canal was a testicle, and from this ran a fibromuscular cord connecting it with a second testicle in the scrotum.

CASE 9. Reported by Bottaro.[2]

Patient, age 13, had no history in his family of hernia or testicular anomalies. An oblong body about the size of a walnut was noted in the right inguinal region. This was somewhat sensitive and was reducible but a part of the mass remained in the inguinal canal. The left inguinal canal was found to be free and a diagnosis of abdominal retention of the left testicle was made. At operation two cords and two vaginal processes were noted extending down the inguinal canal, one going to a testicle in the scrotum, the other to one in the inguinal canal.

CASE 10. Reported by Lowe.[3]

Patient, age 3, was brought to the hospital to be operated on for a left inguinoscrotal hernia. The hernia appeared to be congenital but no reliable history was obtainable. When the structures in the canal were being isolated from the sac, two cords were discovered and these were traced to two testicles lying in the scrotum. They were each the size of a normal single testicle. After the sac was ligatured the testicles were returned to the scrotum. After this reduction the scrotum appeared highly unsymmetrical, the left side being very full and the right quite empty.

CASE 11. Reported by Marsh.[4]

Patient, age 3, was operated on for a large congenital hernia of the left side. Upon exposure of the ring two cords were found passing down to two testicles which were inclosed in one tunica vaginalis. The child died of shock some 36 hours later and at autopsy a careful dissection of the parts was made. There was only one vesicula seminalis, situated on the left side, and it was considerably larger than normal. In connection with it was a very large vas, as thick as an ordinary drawing pencil, which took the normal course as far as half an inch from the internal ring, where it divided into two of equal size which passed down the inguinal canal into the scrotum to the two testes. The right spermatic artery crossed over the middle line about three inches below the umbilicus and meeting its fellow of the opposite just inside the internal ring joined with it to form a single trunk. This trunk divided again before reaching the external ring, the two vessels being distributed to the testes in the ordinary manner.

CASE 12. Van der Horn van den Bos[5] presented a case in which incidentally in the course of a hernia operation he found that both testicles had passed through the right inguinal canal into the right side of the scrotum.

CASE 13. Reported by Widhalm.[6]

Patient, age 47, was married and had three children. The right testicle was somewhat atrophic. He had had a hernia on the left side since childhood. The sac was filled with omentum and there was marked cyst formation. There was a hydrocele about the size of a fist on the cord, and lower down a smaller cyst which contained two testicles of equal size. Behind they were united by a band-form epididymis and off from this came two independent vasa.

[1] Riforma med., 1909, xxv, 1325; ref. Jahresb. u. d. Fortschr. d Chir., 1909, 1067.

[2] Policlinico, 1910, xvii, 1539.

[3] Brit. M. J., 1911, ii, 513.

[4] Brit. M. J., 1911, ii, 1354.

[5] Ref. Zentralbl. f. Chir., 1911, xxxviii, 353.

[6] Wien. med. Wchnschr., 1911, lxi, 1498.

PRIMARY CHORIO–EPITHELIOMA OF FALLOPIAN TUBE FOLLOWING RUPTURED ECTOPIC GESTATION[1]

By HARRY J. HARTZ, M.D., PHILADELPHIA
Demonstrator of Gynecological Pathology, Jefferson Medical College

PRIMARY chorio-epithelioma of the fallopian tube is of comparatively frequent occurrence when we take into consideration that tubal gestation forms but a small proportion of all uterine pregnancies. Of approximately 300 cases of chorioepithelioma that occurred up to 1905, the primary tubal variety comprised about 3.5 per cent of the total number.

In 1905 Risel (1) made an exhaustive study of primary chorio-epithelioma of the tube and collected 11 cases in the literature which he reviewed in great detail. He reports an interesting case of a woman 35 years of age in whom apparently a chorio-epithelioma followed a tubal abortion.

The woman had had three normal labors, the youngest child was five years of age. For about four months after the onset of vaginal bleeding a bloody tumor, measuring 9x6x5 centimeters, of left tubo-ovarian region was removed. Six weeks after operation symptoms of intestinal obstruction developed and one month following the onset of symptoms, operation disclosed an inoperable bloody tumor in the pelvis between the uterus and rectum. Shortly after operation, the woman died, seven months elapsing between the advent of symptoms and fatal termination. Post-mortem examination showed the genitalia and uterus free from the growth, but numerous metastases were found in the liver and both lungs.

In addition to the above 11 cases recorded by Risel, Leipmann (2) adds 7 more making a total of 18 cases of primary chorio-epithelioma of the tube up to the year 1914. In Rossier's (3) case reported in 1912, the tumor attained the size of a man's head. In one of the two cases reported by Davidsohn, the tumor developed in the stump of the tube which had been removed for a ruptured ectopic gestation. Lefquist's case is also quite interesting.

In 1906 the patient was operated upon for a tubal pregnancy. The tube was cleared of all gestation products but was not excised. Two years later a pregnancy in the same tube recurred, and at operation the tube was removed. Pathological examination revealed an early development of a primary chorio-epithelioma of the tube.

In the majority of the cases reported recurrence was the rule, the patient succumbing to the disease but in a comparatively short time after onset of symptoms.

The case that I am reporting was operated upon in St. Joseph's Hospital by Dr. P. B. Bland, and was referred to him by Dr. Koplin of Trenton, New Jersey. The following history was obtained.

A. S., 34 years of age, white, married. She began to menstruate at 13 years, was regular and normal. The patient was married for twenty years had six normal pregnancies and four abortions. The last pregnancy terminated in abortion four months prior to the onset of symptoms. For two weeks the patient complained of vaginal bleeding, accompanied by severe cramp-like pains in the lower abdomen. A diagnosis of ectopic gestation was made and operation advised. The operation was performed in December, 1913. The abdomen was opened. The right tube showed a pregnancy with rupture. The uterus was enlarged and soft and was the size of pregnancy of about six weeks. The tube and ovary were removed and the abdomen was closed. The pathological report of the specimen is as follows:

The mass consists of tube and ovary and gestation sac in collapsed condition. The tube measures 5 centimeters in length and 4 centimeters in diameter at its widest portion which is situated near the fimbriated end. The lumen is filled with clotted blood and the walls of the tube are considerably thickened. Between the lower border of the tube and ovary there is an irregularly shaped sac in collapsed condition measuring 5 centimeters in diameter and lined by a shaggy, dark red, membrane. Adherent to these shaggy villous-like projections are masses of clotted blood. Under the microscope sections of the tubal wall show an attached placenta. At points the chorionic epithelium extends into the thin wall of the tube for some distance, and there are masses of these cells in the lumina of some of the veins. This involvement of the wall of the tube is more extensive than usual and justifies the term chorio-epithelioma.

Diagnosis. Primary chorio-epithelioma of tube following ruptured tubal gestation.

Two years after operation the patient is in the

[1] Read before Jefferson Hospital Clinical Society, December 17, 1915.

best health. Her menses are normal, lasting three or four days. Her work is arduous, assisting her husband in a grocery store from early morning until late at night; besides which she attends to her regular household duties and takes care of her children and with all this hard work she says she has never felt better in her life.

Leipmann strongly emphasizes the fact that sharp differentiation should be made between primary chorio-epithelioma of the tube and the so-called ectopic chorio-epithelioma. The term ectopic chorio-epithelioma should be reserved for only those cases that designate the location of the primary growth in other structures, and away from the ovumnidus or placental site and reiterates that it is incorrect to apply the term to primary tubal tumors that originate at the placental site. Metastatic or secondary growths occur from the tubal growth just as readily as they do in uterine variety. But, also, after a tubal pregnancy an ectopic chorio-epithelioma of primary growth remote from the tubal placental site has been described.

Primary chorio-epitheliomatous tumors remote from the placental site of the uterus and fallopian tubes have been observed in 21 cases by Findley. In no instance was it possible to trace a direct anatomical connection between the placental site and the primary tumor. The tumors arose during the course of pregnancy, at varying periods after the completion of normal pregnancy, and following complete and incomplete abortions. In nearly all cases it has been possible to trace a direct clinical relation between the pregnancy and the tumor formation. The vagina is most often the seat of secondary invasion of metastases in cases of primary chorio-epithelioma of the placental site, but it is also true that it is the most frequent site of a primary growth. Findley reported 14 such instances in the 21 cases collected by him. The interval between the last known pregnancy and the developement of a chorio-epithelioma varies considerably. It usually occurs shortly after the termination of the pregnancy or may be delayed several years after the last labor or abortion. Recently Outerbridge (6) reported a case of a primary chorio-epithelioma of the vagina that developed eight years after the last known pregnancy. In one of the three cases of chorio-epithelioma of the uterus that I exhibited before the Pathological Society of Philadelphia last year the tumor developed at the placental site in the uterus six years after the last known pregnancy. The onset of symptoms in this patient developed three years after the menopause had occurred.

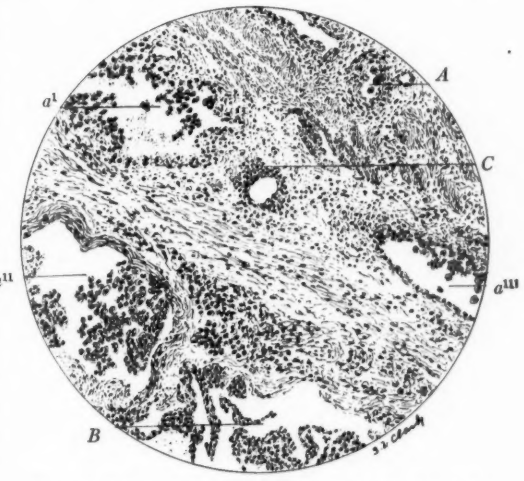


Fig. 1. Primary chorio-epithelioma of fallopian tube following ruptured tubal gestation. *A*, a^{I}, a^{II}, a^{III}, neoplastic cells in lumen of blood-vessels; *B*, tubal lumen, *C*, perivascular small round-cell infiltration.

BIBLIOGRAPHY

RISEL. Ztschr. f. Geburtsh. u. Gynaek., 1905, lvi, 154.
LIEPMANN. Handbuch der Frauenheilkunde, 1914, ii, 182.
ROSSIER. Arch. f. Gynaek., 1912, xcvii, 367.
DAVIDSOHN. Berl. klin. Wchnschr., 1910, xlvii, 1013.
FINDLEY. A Treatise on the Diseases of Women. 1913.
OUTERBRIDGE. Tr. Phila. Obst. Soc., 1915, Nov.
HARTZ. Tr. Path. Soc. Philadelphia, 1914, Feb. 26.

CHONDROMA OF THE PELVIS[1]

By J. HUBER WAGNER, M.D., Pittsburgh
Assistant in Clinical Pathology

NUMEROUS articles have been written upon true chondroma and other forms of cartilaginous tumors arising from various parts of the body. These tumors whether enchondroma, ecchondroma, osteochondroma, chondrosarcoma, or esteochondrosarcoma were, by most authors and especially those of the earlier times, classified as enchondroma. Since 1836, when Jean Muller gave the first complete description of enchondroma, until the present day, a hundred or more articles upon the subject are readily found in the literature. Most of these articles appeared in the French and German literature before 1890. Since then relatively few reports have appeared and only a few of them, dealing mostly with the report of cases, in the English. In this paper, I have attempted to summarize the work of others as well as give a description of three cases of enchondroma of the pelvis coming under our observation.

Chondromata are tumors composed of cartilage-cells with a varying amount of matrix and connective-tissue stroma. These tumors may be composed of any of the three types of cartilage, hyaline, elastic, or reticular, or may be composed of any two or all three types with variable proportions of each. However, the tumor most frequently met with is that of the hyaline variety. In the latter there is an attempt to reproduce the true hyaline cartilage, with relatively few cells scattered sparsely throughout a homogeneous matrix.

Classifying chondromata according to their manner of origin, they are spoken of as ecchondromata or enchondromata. Ecchondromata are outgrowths of cartilage occurring in regions where cartilage is normally present, as in the region of a joint, the larynx or trachea. Such a tumor results through a process of hyperplasia or overgrowth of cartilage. Ecchondromata are homoplastic. The enchondromata on the other hand are masses of cartilage or cartilaginous tumors having no connection with areas of normal cartilage formation. These are considered under the heteroplastic group and develop where cartilage is not normally found.

In the gross these tumors vary considerably in shape and size. They are, as a rule, irregularly globular and range from the size of a hazelnut to a mass 100 centimeters in circumference. They may be single or multiple. As a rule, and especially those which attain a large size, present a lobulated surface and are attached to the parent tissue in a sessile manner. They are surrounded by a capsule of fibrous connective tissue which sends trabeculæ into the tumor dividing it into many lobules of variable size. These trabeculæ carry nutrient blood and lymph-vessels. In color these tumors vary from white to bluish gray.

On section, the cut surface presents a bluish ground-glass appearance in which white bands of connective tissue divide the tumor into various sized lobes. In consistence, the enchondroma is elastic, but this may vary from a soft and gummy character to bony hardness.

Degeneration of these tumors, due to the limited supply of nourishment of those portions of the lobules most removed from the trabeculæ which carry the blood and lymphatic supply, is quite frequent. The degeneration may be myxomatous, calcareous or fatty, and in frequency occurs in the order named. Occasionally a well-defined mass may undergo myxomatous degeneration leading to the development of a true cyst, or the whole tumor may be composed of a myxomatous matrix in which very few cartilage-cells are seen, a myxochondroma. Some specimens show the deposition of calcium salts in the matrix with a shrinking of the cartilage-cells giving rise to a type of calcareous degeneration but without bone formation. Fatty degeneration is described by some authors as an overabundance of fat droplets in the cellular cytoplasm, where it is normally present.

[1] From the Pathological Laboratories, University of Pittsburgh.

Degeneration is more likely to occur in those tumors of the homoplastic group or ecchondromata, where the trabeculæ are not so abundant, and where there is less tendency to form lobules.

The pelvis in view of its embryological development and numerous centers of ossification, its articulation and relation to other parts, is a not uncommon site of chondromata and has many locations from which they may arise. These are (1) from cartilage at the symphysis pubis, (2) from the cartilage of the ischiosacral synchondrosis, (3) from the cartilaginous disc at the sacrovertebral articulation, and (4) from the cartilage of the acetabulum. The tumors arising from the above-named places are of the ecchondroma group. However, they may also arise from "cell-rests" which may be located at (1) the junction of the ascending ramus of the ischium and the descending ramus of the pubis, (2) the junction of the acetabulum and the ilium, ischium or os pubis, (3) any portion of the pelvic bones where connective tissue exists, or (4) the tumor may arise by extension of growth from the surrounding parts. These are of the nature of enchondromata.

Clark reported one case of chondroma of the pelvis occurring in a middle aged woman. This was first observed as a tumor above the hip, and in the presence of other signs a diagnosis of medullary cancer of bone was made. The patient became rapidly emaciated, anæmic, and died. At autopsy all of the os innominatum was involved in a tumor mass. The tumor measured 8½ x 9 inches, filling the pelvis and displacing the rectum, vagina, and bladder. Microscopic examination showed the tumor to be entirely composed of cartilage and its malignancy was due to its position.

An enchondroma of the pelvis developing at the site of injury was described by Potter. The patient was a female 37 years old, who gave a history of a fall ten months previously and two days before confinement. In falling she struck her buttocks on a stone floor. The injured area was quite painful and tender for a few months. Five months after the injury she noticed a small hard swelling on the right buttock. The mass enlarged and grew along the ascending ramus of the ischium and descending ramus of the pubis, reaching the size of a six months' fœtal head. It filled the pelvic outlet causing difficult urination and defæcation and preventing intercourse. At operation the tumor had an irregular surface and was covered by a fibrous capsule. Microscopic examination showed it to be composed of a fibrillated cartilage, frequently showing several cartilage-cells in single lacunæ. Many areas of calcareous degeneration were present in the tumor.

Several other similar cases with a history of trauma at the site of tumor formation have been described by Halthouse and others. In his researches Wartmann described eight enchondromata, two from the pelvis, four from the hand, one from the lung, and one from the parotid gland. He has studied some five thousand sections of these tumors with the following conclusions. He confirms the opinion of Virchow, who indicated that enchondromata arise from connective tissue. He also claims that by a process of metaplasia the endothelium of lymph- and blood-vessels may give rise to enchondromata, and further that many chondromata arise from cartilaginous emboli within the blood-vessels.

The following are three cases of enchondromata of the pelvis which have come under our observation. The first two originated in the pelvic bones while the last had its origin in the femur, and by metastasis extended to the pelvis.

Case 1. Mr. E. H. K., age 38 years. Occupation, farmer (white). He has always had good health. Two years previously the patient received a sharp injury by being thrown on an iron rod. It did not trouble him much at the time, but later he noticed a small growth at site of injury.

On examination there was found on the inside of the left thigh and below the perineum a hard immovable growth about the size of a man's fist adherent to bone. The soft tissues over it were not involved. The glands were not enlarged. He was not inconvenienced in walking. There was slight pain which radiated toward the knee. There was no cachexia nor loss of weight. His general condition was good.

An operation was undertaken under general anæsthesia. An incision was made along the inner side of the thigh, transverse to the tumor. The tumor which was adherent to the ischium and arose from

the ascending ramus was chiseled away from the bone and some of the tissue in the neighborhood was removed. Recovery was good. The patient left the hospital 41 days after entrance and thirty-nine days after the operation.

Pathological examination. This tumor was a large mass about the size and shape of a man's fist. It measured 10 x 7.5 x 6.5 centimeters. The surface was very irregular and nodular. It was composed of nodules varying in size from a pin head to a marble. The tumor was covered by a capsule of dense connective tissue of a glistening character. Scattered diffusely over the tumor mass were small lobules of yellow fat. These were bound to the fibrous tissue capsule. Over about one-fourth of the surface the capsule was missing. Here the tumor had been separated from its attachment. This part was very rough and had many fibrous tags hanging to the surface. In many places it had the appearance of the pulp of an apple and was finely granular. This cut portion was studded with fine chalk-like areas varying in size from a pin head to a large pea or bean. These areas were very irregular in outline and of a calcareous nature.

On cutting through the tumor it was found to be composed of many distinct nodular masses of cartilage. Each mass was definitely outlined but was united to the neighboring lobules by dense fibrous tissue. The cut surface was of bluish gray color and had a finely granular or frosted appearance. In the center of several of these there were irregular chalky masses of calcification. Throughout the tumor there were thick strands of dense white fibrous tissue.

Microscopic sections of the tumor showed it to be mainly composed of cartilage and fibrous tissue. The latter save for the main trabeculæ was small in amount and passed through the mass in all directions, dividing it into small lobules. This connective-tissue stroma was loosely arranged and contained a relatively small number of nuclei.

In some parts of the sections the lobules of cartilage were mainly composed of a clear hyaline matrix in which the cells were sparse. The cytoplasm of the cells was contracted leaving almost vacant lacunæ save for the centrally placed nucleus. Again in other places the cells were more abundant and the matrix less in amount. This did not have the appearance of mature hyaline cartilage, but had a streaked appearance due to prominent fibers in the matrix. Here the cartilage was not arranged in the well-defined lobules, but had an irregular architecture with ill-defined borders. At times it was difficult to differentiate true cartilage-cells from the fibrous connective-tissue cells of the trabeculæ.

At the border of the sections and adjoining the fibrous stroma, the cartilage-cells were lying in meshes of collagen fibers of the connective tissue, but as one advanced from the fibrous trabeculæ, the cartilage-cells took on a more mature appearance and the collagen fibers became fewer in number, gradually disappearing from the hyaline matrix. The cell walls were very indistinct and could not always be made out. This was particularly true where the cartilage was more mature. In other parts of the specimen, as many as ten cartilage-cells were surrounded by a single indented capsule. Diagnosis: Chondroma of the ischium.

CASE 2. Mr. Jos. B., age 52 years. Occupation, carpenter (negro). Patient had been in good health until 18 years ago (34 years) when he had typhoid fever. He made a good recovery and was perfectly well until five years ago (47 years) when he had trouble with his bowels and was compelled to use purgatives. Gradually, but slowly, constipation became more marked. Two years ago he had frequency of micturition, associated with some pelvic pain. Gradually, but slowly, his condition became worse. Six months ago he noticed a hard firm enlargement above spine of the left pubic bone. Being a carpenter he attributed the development of the mass to injury occasioned by the use of an auger. This tumor gradually became larger. One month ago he noticed a similar mass to the right of the pubis. He progressively became more constipated and urination was more frequent. He has not lost much (if any) in weight.

On examination he appeared to be a fairly well-nourished man. A firm tumor was found projecting above the pubis on either side and filling up the anterior portion of the pelvic cavity. The finger could be inserted into the rectum for a distance of about one inch. There appeared to be but a small space posteriorly for the bowel. Examination elicited no tenderness.

A large nodular mass, composed of numerous lobules of bluish white color was removed from the posterior surface of the horizontal rami of the pubic bones. The tumor extended laterally on both sides of the symphysis. The patient made an uneventful recovery.

Pathological examination. The tumor mass was very irregular and nodular and composed of various kinds of tissues. It had the shape of a large potato and measured 13 x 7 x 5.5 centimeters. The tumor was covered in an irregular manner by a fibrous capsule to which many fibrous tags were attached. There were many thick fibrous bands running over it in various directions. In places the tumor was of firm, bony consistency, in others it was more elastic and at times it even appeared cystic. There were about thirty smaller pieces of tumor which during removal had been separated from the main mass. They varied in size from a walnut to one-third the large tumor and were similar to it in structure.

For the most part the tumor was occupied by lobular masses of cartilage, which had a dense, bluish white, glistening appearance, and surrounded by a definite fibrous capsule. On section, some of these masses of cartilage seemed to coalesce with the neighboring masses. In other parts, they existed as separate lobules and were attached only through intervening thick bands of fibrous connective tissue. These bands traversed the tumor in all directions

and appeared to arise from the surrounding fibrous capsule. On closer inspection this cartilage was a bluish-gray color, it was smooth and had the appearance of frosted glass. This cartilage was quite elastic. In another portion of the tumor, there was some firm white calcified tissue, which was irregular and nodular, representing or suggesting calcification of definite cartilaginous nodules. These calcified areas could easily be broken into small nodular masses, each of which was separated from the next nodule by a capsule.

Attached to and embedded in the dense fibrous capsule was a mass of fat which was of a dull yellow color. On section through the cystic portion of the tumor, the interior was found cavitated in a very irregular manner. These cavities extended through the tumor mass in many directions. The cartilaginous substance in this region and surrounding the cavity was very soft and easily broken. In the thick bands of connective tissue were many congested blood-vessels. The tumor had in places a pink hue.

Microscopic sections of the tumor showed it to be composed of a hyaline cartilage. The cells were of various sizes and shape and lay in lacunæ surrounded by a matrix of varying consistency. Groups of cells closely or loosely arranged were found. The cells were mostly oval, but a gradual transition, from stellate, to oval forms were also frequently seen. Some of the cells were surrounded by a capsule or thickened portion of the matrix. Others showed no capsule whatever, and still others showed a single capsule surrounding from three to twelve cells. In some of the cells a fine network was seen extending from the contracted central mass to the cell-wall. Running through the tumor were strands of fibrous connective tissue which contained blood-vessels. Several of these were seen to change by gradual transition into cartilage cells of the hyaline variety. The cartilage gradually assumed a more adult type as one advanced from these fibrous trabeculæ inward. The matrix of the cartilage had a homogeneous pink hyaline appearance. In some places, however, minute fibers could be distinguished in this substance.

Case 3. Mr. S., age 18 years. Occupation, student (white). For the clinical report I am indebted to Dr. B. Z. Cashman of the St. Francis Hospital. About five months previously a small growth was noted on the external surface of the right femur. Two months later this had extended to the inner side of the shaft. The patient lost five pounds in weight during the last few months. There had been some pain in the femur for the last month and some discomfort on the side of the right hip.

A firm mass was found over the inner part of the right thigh from trochanter to middle third. There was no pain on pressure. No change was to be observed in the overlying skin or veins. No other mass was present in the pelvis. The X-ray showed an egg-shaped softening below the greater trochanter.

On January 21, 1915 a small piece was excised for examination, and a diagnosis of chondromyxoma was made. A notanda was added suggesting liability to recurrence.

An operation was undertaken for the removal of the growth. The mass was easily stripped from the femur and pelvis by the hand. While removing the tumor a sensation like running the hand through a bowl of cracked ice was obtained. The operation was followed by treatment with the actual cautery. Patient discharged February 28.

March 12, 1915. One and one-half months later a mass the size of the original was found beneath gluteus maximus and attached to the femur and ischium. This mass was also removed and cauterized. April 3, 1915. No evidence of recurrence. April 24, 1915. A mass was noticed below the descending ramus of pubis and attached to the femur. Patient was referred to an X-ray expert, who treated the case for four weeks with X-rays. The mass became softer but larger. The patient then sustained a pathological fracture of the femur. A sinus developed and blood drained from the area of injury. July, 1915. The patient was treated at Baltimore for 43 hours continuous radium. The mass continued to grow. October 20, 1915. Patient home. Marked œdema and redness over the mass which appears smaller. General health somewhat improved. February, 1916. Patient died. No autopsy.

Pathological report (January 21, 1915). There were received numerous small irregular pieces of soft cartilaginous tissue, representing a tumor about the head of the femur. The largest of these masses was 4 x 3 x 2.5 centimeters. These pieces of tissue were of a pale translucent appearance. The tissue was of the peculiar consistence of young cartilage and was quite friable. Running through it were strands of fibrous tissue forming trabeculæ and carrying small blood-vessels. The tissue was of a uniform structure and appearance. The cut surface was smooth, glassy and firm. No areas of necrosis were observed. The tissue was distinctly translucent and in the smaller pieces which were very numerous and sometimes blood stained, the fibrous trabeculæ stood out quite prominently as opaque, white strands. A firm stroma was seen to penetrate the solid gelatinous substance from these trabeculæ. In many of the smaller piece the surface was gritty, owing to the presence of small particles of calcium salts. One small piece not over 1 centimeter in diameter consisted chiefly of compact cancellous bone. This was covered on one surface by the cartilaginous tissue.

Microscopic. Sections of the tumor mass showed it to be composed of a matrix of a hyaline character, in which many cartilage-cells were found. These cells were of irregular size and shape, some being oval, large and multinucleated. Many were spherical having a wide protoplasmic ring and contracted lacuna. Others were rather spindle shaped or stellate. No mitotic figures were observed. The cells were rather loosely distributed and nowhere

were they arranged in compact groups. The intervening substance was hyaline and appeared to be soft and gelatinous. It had not the solid consistence of the normal matrix of cartilage. Diagnosis: Chondromyxoma of femur. Notanda: The very soft character of the tumor and the variety of cartilage-cells, within it indicate the immature nature of the tissue. Tumors of this nature arising from cartilage have been shown to recur after removal.

Pathological report (February 2, 1915). There was received a 500 cubic centimeter jar full of cartilaginous masses or nodules looking like broken meat jelly. These pieces were similar to those described before. The largest measured 9 x 7 x 2.5 centimeters and was very irregular. On section the cut surface was smooth, translucent, and cartilaginous. The tissue was lobulated and divided by numerous fibrous trabeculæ, and although it was thus well supported, it was exceedingly friable. When the surface of the tumor was slightly scraped to remove the moisture, it appeared much like smooth, finely frosted glass. It was, therefore, dull and translucent.

Microscopic. Sections of the tissue showed a structure resembling cartilage, save that the matrix appeared less dense and contained an irregular reticulum. The cells were irregularly scattered, some small, others large, like cartilage-cells. In places again these cells were not contained within lacunæ, but appeared spindle shaped like myxoma cells. Here and there were found trabeculæ, which appeared to shade off, in gradual transition, to the tumor tissue. The trabeculæ appeared more cellular than the cartilaginous tissue. The blood-vessels were quite thin walled, although definite arteries were encountered. Mitotic figures were not seen. Diagnosis: Chondromyxoma of femur.

In our own first two cases we see that the tumors have occurred in healthy males, laborers by occupation. Their ages were 37 and 47 respectively when the tumors were first noticed. The tumors developed after and at the site of a definite injury, in one case after a sharp trauma and in the other after a more prolonged and milder injury. Both arose from the same portion of the pelvis. They were both removed by a surgeon and showed no evidence of recurrence. Microscopically they were seen to be true enchondromata, one showing calcareous degeneration. The cells were similar to those of adult hyaline cartilage and the tissue farther removed from the trabeculæ had the typical appearance of hyaline cartilage. In those places farthest removed from the trabeculæ where the supply of nourishment was limited, the intervening hyaline substance was at times greater in amount and of a myxomatous nature. In each of these tumors the various steps of transformation (metaplasia) of connective tissue into cartilage was seen.

TABLE I.—CASES COLLECTED BY AUTHOR

Author	Year	Sex	Age	Trauma	Locations
Letenneur	1855	M.	32	Definite history	Right ilium, trochanter and femur.
Parise	1862	M.	37	No definite history	Rami of pubis and ischium (left).
Molinier	1865	F.	34	No definite history	Sup. part of os ilium and sacroiliac synchondrosis.
Francois	1865	F.	35	No definite history	Region of the buttocks
Weinlechner	1875	M.	62	Not stated	Sacrum and great trochanter of femur (right).
Bayer	1903	M.	44	Not stated	Left (body of pubis) symphysis.
Bayer	1903	M.	33	Not stated	Right ilium.
Opokin	1906	F.	33	Not stated	Left pubis.
Korte	1911	M.	43	Not stated	Symphysis pubis and ilium (right).
Nathan	1914	F.	23	Not stated	Rami of pubis and ischium.
Author	1916	M.	37	Definite history	Ramus of ischium (left).
Author	1916	M.	47	Definite history	Body of pubis at symphysis.

The third case occurred in a young man 18 years of age, giving no history of trauma, and arising primarily on the innerside of the femur. A section of this growth showed the cartilage-cells to be embryonic in type and the intervening substance was soft and gelatinous. The diagnosis of the condition in the tissues, on the first occasion of removal, was accompanied by a note stating that "tumors of this nature arising from cartilage have been shown to recur after removal." Six weeks later the tumor involved the pelvis. We have included this case in our report to illustrate the quality of malignancy which may at times be associated with this type of neoplasm.

Schoppig in 1907 was able to collect 93 cases from the literature. Of these, 54 occurred in women which he analyzed as follows: Twenty-two gave no obstruction to labor, while the remaining 32 gave difficulty in pregnancy. A large number encroached so

decidedly upon the pelvis as to demand cæsarean section. Only a few cases in his series had been studied to show the influence of trauma in the development of the tumorous masses. Out of a group of eight in which inquiry of previous injury was made, there were five in which a definite relation was shown.

To the above series of 93 cases, I have been able to find 10 more in the literature and have also added 2 of my own, not including the one arising in the femur and metastasing to the pelvis (Table I).

Many different views have been held by the various authors as to the origin and development of enchondromata and of these we will discuss the more important. Traumatism whether severe or mild has been claimed to be a very important factor in the causation of these tumors. In our own two cases, having their primary origin in the pelvic bones both have followed a definite injury. Letenneur makes the statement, "that enchondromata almost always develop after an injury to the bone." He also cited Virchow as holding the same opinion. Just in which manner trauma and irritation act as stimuli in the production of these tumors is not definitely known. However, in a number of reported cases there is a history of previous trauma or irritation at the site of the tumor, and in those cases where no definite history of trauma is offered, many tumors are found to have originated in areas very liable to injury. Of the 12 cases which we have tabulated, a history of injury was sought in 6 and was found associated in 3. Schoppig, in 8 cases in which reference was made to trauma as one of the etiological factors, found 5 giving a definite history of trauma. In the other cases where no history of injury had been mentioned, the author laid particular stress upon the possibility of its presence.

Sudler reported the development of chondromata in various parts of the body, as the result of trauma. That these tumors may arise from fibrous connective tissue by a process of metaplasia seems in the light of previous studies and our own, very probable. Helmholtz accidently induced the formation of cartilage from connective-tissue cells, by injecting a solution of sudan III into the tissues of a rabbit's ear, to study its effect on the epithelium. Two months after the primary injection, pieces of the rabbit's ear were removed for examination. Under the microscope, these showed the various stages of the transformation of connective-tissue cells into cartilage-cells and were described as follows: The connective-tissue cells first retract their processes and lose their distinct outline. The nuclei become larger and more vesicular. The interstitial substance loses its fibrillar character and stains a pale pink. The cell-body then retracts from the surrounding substance and lies free in the lacuna. Before the cell recedes and imbeds itself, it is impossible to say whether the cell is a cartilage cell or a fibroblast. One of the views advanced by the same author as to the probable explanation of the above, is that the connective tissue, by the stimulation of sudan III, has returned to the embryonal type of mesoblastic cell with the potential qualities of forming any of the stroma elements of the mesoblastic type. Similar results were obtained by Harvey, by painting the outer surface of the aorta of rabbits with silver nitrate.

These steps in the transformation of the fibrous connective-tissue cells of the trabeculæ into cartilage-cells have been observed by me in two of the cartilaginous tumors studied. Incidentally both of these tumors arose from the pelvis. Wartmann, Gibbs, and other authors have observed and described this same process in enchondromata occurring in different regions in man and other mammals. In his discussion on the origin of these tumors Wartmann states his belief that enchondromata commonly arise from connective tissue by the process of metaplasia. Many authors agree with Virchow, who held that enchondromata may develop from embryonic "cell-rests." These islands of cells from the primary mesoderm develop to a certain stage of specialization and then remain in a latent state during the development of bone, and later in life under the proper stimulus give rise to one of the many cartilaginous tumors. He further states that these "cell-rests" and enchondromata are more likely to make their appearance following rickets, where ossifica-

tion and growth of bony and cartilaginous parts are much retarded.

Enchondromata may also result from an inclusion of cartilage-cells (anlage), during the development of certain organs. Those likely to occur in the pelvis are enchondromata of an undescended testicle or an ovary. These organs are developed in close apposition to the vertebral column and may include an anlage of cartilage from the intervertebral discs, which later may take on the power of growth and give rise to a tumor. This was shown by Virchow to be the probable source of enchondromata of the parotid gland in which an "anlage" or inclusion was obtained from the branchial arches.

Francois reported a case of enchondroma of the ovaries occurring in a patient 74 years of age, but does not give any view as to their mode of origin. On the other hand, Wartmann in his classical researches upon enchondromata has observed and described the endothelium of the blood- and lymph-vessels retroverting to a type of embryonic mesodermal tissue from which it then developed into cartilage-cells and formed tumors.

Enchondromata of the pelvis usually develop during the third and fourth decade. Of the 60 cases reported in which attention was called to the age of the patient, 46 have occurred between the age of 20 and 40 years, and 29 of these between 30 and 40 years. Considering these tumors in the order of their frequency in particular locations, those arising in the pelvis stand fourth, the bones of the hand, femur, and tibia respectively being more frequently involved in the order named. In these latter locations, they very often are the late outcome of arthritis and particularly of arthritis deformans. Heredity seems to play little or no part whatever in the development of chondromata, although those occurring on long bones have been found in three successive generations. These tumors occur about equally in both sexes. Of 105 cases reported, 59 occurred in females.

Considering these tumors in regard to their rate of growth and duration one can say very little, as they are usually removed surgically at an early period. However, one can say that they are, as a rule, of slow growth, but may suddenly take on the qualities of rapid growth and cause the death of the patient. Livert in his statistics on enchondromata in general, taken before the days of modern surgery, reports 12 cases lasting from one month to two years before death, 11 cases from two to ten years, 12 cases of ten to twenty years' duration, and 3 cases more than forty years' duration.

Many enchondromata of the pelvis are clinically malignant, mainly because of their position in relation to the various pelvic organs. This was the more true before the days of antiseptic and aseptic surgery, when the tumors were allowed to develop to an enormous size. Some of these tumors possess characters of true malignancy as is shown in one of our tumors having metastases. This process, it is pointed out by Wartmann, takes place by the development of buds, which grow into the lumina of vessels, are broken off and carried to distant parts. The organ most frequently involved is the lung. Some of the tumors spread to distant parts by continuity and in this way show their malignancy. This is more apt to occur in tumors of a soft character whose cells are irregular in size and shape and simulate in appearance embryonic cartilage-cells. The matrix of these tumors is soft and of a gelatinous nature, often myxomatous. This is well shown in our Case 3, with metastases involving the pelvis. Francois cites a case reported by M. Dolbeau showing a metastasis of enchondroma of the tibia to the pelvis. The more cellular these tumors are, the more prone they are to develop typical sarcomatous masses of fibrous type.

Gibbs reported a case of enchondroma in the breast of a bitch, growing side by side with a sarcoma, but having no connection with it. In some instances it was impossible to differentiate the two types of cells save by special staining methods. It is possible that many cases of this kind with metastases and other signs of malignancy have occurred in the human, and hence reported as malignant enchondromata.

Enchondromata may be differentiated in the gross from similar growths by observance of the following: These tumors are definitely

outlined and globular in shape, while malignant tumors are irregular in shape and outline. Pain is not so marked, if present at all, and not of the lancinating type as sometimes found in malignancy. Pain in exostoses is present from the beginning while in enchondromata it is absent until the growth is quite large. There is no involvement of lymphatics and only in rare cases are the blood-vessels engaged. Keen is of the opinion that enchondromata arising in children are usually benign while those arising in later years are more liable to become malignant.

From our experience and study as well as that of others, it is evident that enchondromata of the pelvis most frequently arise in fibrous connective tissue and develop through a process of metaplasia following a stimulus, usually a definite injury. Furthermore, their clinical malignancy is mainly dependent upon their position, and only rarely do they adopt a sarcomatous character and show true tissue malignancy.

I wish to acknowledge the valuable assistance given me by Dr. O. Klotz in the preparation of this paper.

BIBLIOGRAPHY

Borst. Geschwulstlehre, 1902.

Bayer. Arb. a. d. Geb. d. klin. Chir., Wien., 1903, 40.

Bergman. Deutsche med. Wchnschr., 1885, xi, 715.

Clarke. St. Thomas Hosp. Report, Lond., 1887, xvii, 17.

Deville. Bull. Soc. anat. de Par., 1848, xxiii, 21.

Dolbeau. Bull. Soc. anat. de Par., 1859, xxxiv, 338.

Dorn. Ein Fall von Beckenenchondrom. Inaugural Dissertation, Munich, 1904.

Dintler. Upsala Laekaref. Foerh., 1874, ix, 215.

Francois. Contribute a l'etude de l'enchondrome du bassin. Paris, 1887.

Gibbs. Med. Rec., N. Y., 1889, xxv, 86.

Halthouse. Tr. Path. Soc. Lond., 1856, viii, 367.

Helmhotz. Bull. Johns Hopkins Hosp., 1907, xviii.

Korte. Deutsche med. Wchnschr., 1911, xxxv, 619.

Keen. System of Surgery. Philadelphia, 1912.

Letenneur. J. de la sect. de méd. Soc. acad., Loire. Inf. Nantes, 1857, xxxiii, 331.

Malinier. Bull. soc. de Par., 1865, xl, 550.

Nathan. Proc. Path. Soc. Phila., 1914, xvii, 7.

Ohokin. Russk. chir. arch., St. Peterb., 1906, xxii, 776.

Parise. Bull. méd. du nord., Lille, 1862, ii, 3.

Potter. Westminster Hosp. Report., Lond., 1888, iii, 170.

Ribbert. Geschwulstlehre, 1904.

Sudler. Surg., Gynec. & Obst., 1914, xix, 761.

Stengle and Fox. Philadelphia, 1915.

Schoppig. Monatschr., f. Geburtsh. u. Gynaek., 1907, xxv, 845.

Virchow. Die Krankhaften Geschwulste. Berlin: 1863–1865.

Wartmann. Recherches sur l'enchondrome. Inaugural Dissertation, Strassburg, 1889.

Welch. British M. J. 1889, i, 587.

Weinlechner. Ber. der K. K. Krankenanst. Rudolf Stiftung in Wein, 1875, 325.

DEPARTMENT OF TECHNIQUE

THE APPLICATION OF ANOCI-ASSOCIATION TO OBSTETRICS[1]

The Combined Use of Scopolamine, Nitrous-Oxide-Oxygen and Local Infiltration

By CARL L. HOAG, M.D., San Francisco
Assistant in Surgery, University of California Medical School

IN a paper read before the Pan-American Medical Congress last June (1), I pointed out the way in which the principles of anoci-association could be applied to obstetrics. I wish briefly to review these points before reporting the results of my work since that time.

The principles of anoci-association are too well known to need description here. The acceptance or rejection of this system constitutes one of the most warmly debated subjects of present day surgery. There are those who are firmly convinced of its merits and others equally sure that it is only a fad, soon to follow the numberless panaceas once hailed with enthusiasm, but now forgotten. Whatever may be its future as a system, it has already left its mark upon the technique of every clinic in promoting the more careful handling of tissues, sharper dissection and reduction of trauma.

The principal objections seem to be that there is a lack of muscular relaxation under nitrous-oxide-oxygen, and that there is difficulty in securing it by local nerve-blocking.

During the past three years, it has been my good fortune to study a large number of cases operated under nitrous-oxide-oxygen and anoci-association. This experience has convinced me that success depends almost entirely on the care and thoroughness with which the local infiltration is done; and those who have succeeded have done so by making the nerve-blocking as complete as that necessary for operation under local anæsthesia alone.

Since the appearance of the articles by Webster (2) and Lynch (3) in March, 1915, the use of nitrous oxide in obstetrics has rapidly increased. When we remember how many surgeons have discarded it on account of the lack of relaxation in the abdominal wall, we cannot help feeling that the percentage of severe perineal tears must rise, unless the pelvic muscles should happen to be very different in their reactions under the gas. Since there are no reasons for expecting such a difference, I believe we should be prepared to meet the difficulty. One way would be to change to one of the more relaxing anæsthetics, such as ether or chloroform at the time of delivery; another would be to use nerve-blocking locally. If relaxation can be secured in the abdominal wall by the use of novocaine and quinin-urea, it seems likely that the same results could be obtained in the perineum.

Of the 30 cases receiving perineal injections, 20 were given nitrous-oxide only, Group I; four were given nitrous-oxide-oxygen until the time of actual delivery, when chloroform or ether was substituted, Group II; and six received chloroform in the usual way, Group III. The perineum in all cases was injected with 0.25 per cent novocaine, varying in amounts from 60 to 150 cubic centimeters. Eleven received in addition from 30 to 40 cubic centimeters of 1 per cent quinin-urea solution each. The maximum amount of the two solutions injected in any one case was 175 cubic centimeters. The injection was made as the head appeared in sight. The vulval edges were turned back and a long needle was inserted at the mucocutaneous border, the fingers of one hand being in the vagina to note its position. At this period, the perineal floor is flattened out by the oncoming head, but not stretched to any degree. Even though the field is large, both the levator ani muscles and the perineal body can be readily infiltrated. Novocaine was injected first and the quinin-urea immediately afterward, when used.

For the purposes of this paper, we are concerned chiefly with the 20 cases in Group I that received nitrous-oxide-oxygen only. Seventeen of these received from one to five doses of scopolamine during the first stage before nitrous-oxide-oxygen was begun. The initial dose of scopolamine was 1/200 grain combined with either morphine 1/6 grain or narcophin ½ grain. This was followed usually at irregular intervals by the same dose of scopolamine without the

[1] Read before the San Francisco County Medical Society, February 12, 1916.

TABULATION OF CASES

	Group I	Group II	Group III
Number of Cases	20	4	6
Received	N^3O-O	N^3O-O plus chloroform or ether	Chloroform for delivery.
Age	18 to 30. Average 23	26 to 34. Average 25	16 to 31. Average 25.
Para	I–19. II–I	I–3. III–I	I–3. III–3.
Position	6 R. O. A.; 13 L. O. A.; 1 R. O. P. and brow	All L. O. A.	2 L. O. A.; 3 R. O. A.; 1 R. O. P.
First stage	6½ to 46 hours. Average 16 hours, 40 minutes	11 to 23½ hours. Average 16 hours	9 hours, 15 minutes to 33 hours Average 18 hours.
Second stage	53 minutes to 3½ hours. Average, 1 hour, 40 minutes	1 hour, 30 minutes, to 3 hours, 36 minutes. Average 3 hours, 30 minutes	1 hour to 4 hours 50 minutes. Average 2 hours, 10 minutes.
On perineum	15 minutes to 1½ hours. Average 41 minutes	31 minutes to 1 hour, 30 minutes. Average 50 minutes	15 minutes to 1 hour, 50 minutes. Average 40 minutes.
Scopolamine	0–5 injections. Average about 3 in 17 cases	One case. 3 injections	None
Perineal injections	Novocaine 60 to 150 ccm. Average 100 ccm. Quinin-urea, in 35 to 40 ccm., 4 cases	80 to 100 ccm. Average 87 ccm. Quinin-urea, 30 to 35 ccm., 3 cases	80 to 110 ccm. Average 92 ccm. Quinin-urea, 30 to 35 ccm., 4 cases.
Relaxation	1 slight. 13 medium. 6 complete	3 medium. 1 complete	5 medium. 1 complete.
Lacerations	7, none, 30 per cent. 1st degree 10, 50 per cent. 2d degree, 3, 15 per cent*. 3d degree, none	3, none, 75 per cent. 1 slight 1st degree, 25 per cent	3, none, 50 per cent. 3, slight 1st degree, 50 per cent.
Forceps	Low, 2 cases. Mid, 1 case (fœtal heart 100)	1st degree laceration, mid-forceps.†	Low in 1 case without laceration.
Baby	19 breathing spontaneously. 1 stillborn	3 breathing spontaneously; 1, delivery mid-forceps, cord around neck, etc., stillborn	6 breathing spontaneously.

*1 mid-forceps, 1 contracted outlet, 1 unattended delivery. †Stenosed cervix, prolonged labor, ether.

morphine or narcophin. In four of the prolonged labors, a second smaller dose of either the morphine or narcophin was given. These drugs were given, first, to reduce the amount of gas used; and secondly, because many of the nervous patients became more quiet and took the anæsthetic better.

It should be emphasized that an excessive amount of scopolamine often proves worse than none, because the patient must be mentally clear to give the proper co-operation with gas analgesia. In none of these cases was the amount sufficient to produce anywhere near the mental condition observed in so-called "twilight sleep." I believe its use in these amounts is just as advisable in obstetrics as in general surgery, and for the same reasons.

Nitrous-oxide-oxygen analgesia was begun before the end of the first stage or at the beginning of the second, according to the distress of the patient and to her ability to pay for the gas.

Pain. There was a marked difference between the private and the clinic patients in regard to the success of the procedure as far as pain is concerned. The private cases, all intelligent women, schooled in the part they were to play, and attended by professional anæsthetists, suffered very little. Some of them had absolutely no pain; others asked for more anæsthetic and complained of distress, but after it was all over could not remember having had much pain. In the other group of clinic cases, conditions were less favorable. The women were less intelligent, some could not even speak English. With the first few cases, the anæsthetic was given with a new type of machine by men unskilled in the use of gas. Under these circumstances, in some cases, the gas did not give enough relief so that choloroform or ether had to be substituted. These are the cases that make up Group II. Later, better results were obtained as regards analgesia, but still not as good as in private cases.

During the delivery of the head, analgesia was succeeded by complete anæsthesia in all cases. I believe this is an important point. It greatly lowers the danger from those sudden, expulsive contractions which so often produce tears. It has been found advisable after years of experience with chloroform, and I do not see why it should not be used with nitrous-oxide-oxygen. In fact, the indications for complete anæsthesia are greater with such a light anæsthetic.

In the first 20 cases, delivered under nitrous-oxide-oxygen and anoci alone, nineteen were primipara and the other a II-para. The ages varied from eighteen to thirty-one, the average was twenty-three years. In all but one, the position was left occipito-anterior or right occipito-anterior. One was a right occipito-posterior which persisted and was delivered as a brow, with low forceps. In spite of this complication, the nitrous-oxide-oxygen worked satisfactorily.

Length of labor. As far as they go, the figures in the nitrous-oxide-oxygen cases indicated shortening of the second stage. The time averaged one hour and forty minutes, which, I believe, is less than is usually seen in a similar group of primiparæ. Certainly, the time was not lengthened.

Forceps. Forceps were used three times. Of the two low forceps cases, one was the brow delivery just mentioned. In the other, they were used to terminate labor after the head had been on the perineum one hour. In a third, mid-forceps were resorted to because the fœtal heart had dropped to 100. This last case had received nitrous-oxide-oxygen during the pains for thirty minutes only. It does not seem, then, that the need for forceps in any one of these cases could be attributed to the anæsthetic.

Lacerations. Careful records were kept: even the first degree lacerations, small skin or mucous tears, were noted. These were present in 10 cases. In the 20 cases there were only three second degree lacerations, each one of which was to be expected under the conditions present. The first was in the mid-forceps case already described; the second had a contracted outlet, and in the third, the head was born unattended.

Perineum. The perinea in the 30 cases were watched carefully for complications attendent upon the injection of novocaine and quinin-urea. No abscesses, sloughs, areas of redness, or infiltration occurred. In a few cases, there was some œdema and considerable tenderness on the second and third day, but apparently no more than in other cases in which it was not used. Those perinea that had to be repaired healed promptly.

Perineal injections. There is no doubt in my mind that the novocaine did improve the relaxation. The perineum is a large field to be thoroughly injected, but the distribution of these large quantities of solution is materially aided by the pressure of the head against the muscles. The quinin-urea[1] in the quantities used was apparently of little service in relieving the soreness after delivery, but it may have aided in keeping up the local anæsthesia in the more protracted cases.

Babies. All but two of the babies in the 30 cases were born alive, pink, and in excellent condition; breathing spontaneously. One was still-born at about eight months. No fœtal heart had been heard for several days. In the other case, the mother, a III-para, had been sent in from the Out-patient Department because the fœtal heart had gone up to 170. The cervix was stenosed; mid-forceps had to be applied and the child was born with the cord tightly coiled about its neck. Nitrous-oxide-oxygen had been given for only fifteen minutes, followed by ether for one hour. This child could not be resuscitated, and death was plainly due to suffocation on account of delay in delivery. In neither of these cases, then, can death be attributed to the nitrous-oxide-oxygen.

[1] It should be remembered in using anoci-association that quinin-urea must not be used in the skin, mucous membrane, gums or cervix, as it sometimes produces sloughs in these tissues.

CONCLUSIONS

1. In conclusion, I wish to emphasize that this experience, brief as it is, is in accordance with that accumulating rapidly on all sides today; that nitrous-oxide-oxygen analgesia is safe to both mother and child.

2. The use of limited amounts of scopolamine during the first stage is a distinct advantage, shortening the time during which gas is required and making the analgesia more complete.

3. The work done so far has encouraged me in the belief that the injection of the perineum is a distinct help in securing relaxation of the outlet. This point gained, gas-oxygen, in experienced hands, will do as well as either chloroform or ether. The lack of any complication whatsoever resulting from the perineal injections should encourage those who feel timid about its use.

4. The combined use of scopolamine, nitrous-oxide-oxygen, and local infiltration offers a practical and efficient means of conducting labor, and extends "anociation," in its broadest sense, to the obstetrical field.

In closing, it is a pleasant duty to thank Dr. Breitstein for the generous and open-minded way in which he gave me access to material at the University of California Hospital. I wish also to thank Drs. Seaver and Gelston for their valuable help in carrying out this work.

REFERENCES

1. HOAG. The application of anoci-association to obstetrics. Calif. St. M. J., 1915, December.
2. WEBSTER. J. Am. M. Ass., 1915, lxiv, 813.
3. LYNCH. Ibid, p. 812.

PERINEAL ANÆSTHESIA IN LABOR

By ROBERT W. KING, M.D., Denver, Colorado

WHILE marked advancement has been made in the realm of anæsthesia as applied to the local and general blocking of the sensory nerves of various parts of the body, it is strange that so little attention has been paid to applying these methods to the sensory innervation of the female perineum—especially since the agitation of "twilight sleep" has engaged the attention of profession and laity. The literature of this subject is remarkable because of its scarcity; the subject apparently has not engaged the attention of American investigators, and practically the only work of importance that has come to my notice has been carried on in Germany.

What work has been done has been directed toward the blocking of the pudic nerve, but this has not received the attention it deserves.

The pain of the dilatation of the cervix is not of the same intensity as that suffered by the birth of the head, and seldom requires anæsthesia of any sort. The suffering caused by the advancing presentation on the perineum has been attributed to the stretching of the soft parts, and this pain is always more severe in primipara than in multipara.

A further knowledge or understanding of the sensory innervation of the female perineum and the part played by Colles' fascia in the production of pain in childbirth will modify this view, and a better understanding of the anatomy of the part will lead to better success in attempting to block the nerves.

By blocking the pudic nerve in the ischiorectal fossa there will be a fair degree of anæsthesia of the anterior triangle and perfect anæsthesia of the posterior. The anæsthesia of the anterior portion will not be perfect, because part of its sensation is derived from the inferior pudendal, genitocrural and ilio-inguinal nerves (Fig. 1), that do not enter the posterior triangle. The major portion of the pain in the second stage of labor is due to the stretching and rupture of Colles' fascia, which is more sensitive than the integument of the part, and which also varies in density and elasticity in different subjects. As Colles' fascia is always more or less torn in the primipara and not so frequently or to so great an extent in multipara, it is readily seen why the suffering is more intense in the former than in the latter.

Anatomically, Colles' fascia corresponds to the lateral extension of the hymen, and like that structure it possesses great sensibility to pain. If this point is fully understood and the sensory paths and fascial planes (Figs. 2 and 3) are studied in the illustrations, it will be possible for the general practitioner to safely and easily block the sensory innervation and deliver the patient painlessly, or at least with a minimum degree of pain, rendering the employment of other anæsthetics unnecessary.

My former objection to blocking the nerve in the ischiorectal fossa has been because of the low vitality of this fat-filled space and the possible danger of puncturing the pudic artery.

Infiltration of the fossa has not been followed by any adverse circumstances, however, and I am now blocking the nerves of both the anterior and posterior triangles of the perineum in women who have given birth to a number of children, or who present evidence of much laceration of Colles' fascia.

There are many apparent advantages of this method over the administration of general or spinal anæsthesia in childbirth or gynecologic operations which make it very desirable that it should receive a thorough trial in clinics having suitable material.

I have had much difficulty in working out the innervation and fascial planes as here given, owing to the lack of suitable material in the dissecting room and the fact that the published works on anatomy that I have had access to, have with one exception, dismissed this important part by referring the student to the male analogies. The later works on obstetrics and gynecology have also shown an unexpected lack of knowledge of this subject, due, perhaps, to the supposed unimportance of an intimate knowledge of the female perineum to the general practitioner.

ANATOMY

The pearshaped space of the perineum is divided into an anterior and posterior triangle by a transverse line passing between the tuberosities of the ischium, midway between the anus and vagina. The lateral angles of the anterior portion vary greatly in different subjects, and the pubic arch must be carefully palpated and the site for injection chosen in reference to the particular patient. The anterior triangle contains all of the sensory nerves involved in childbirth, except third degree lacerations extending posteriorly.

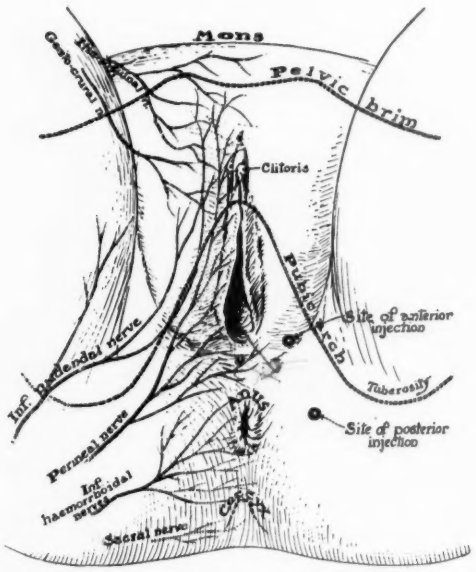


Fig. 1. The right side shows the distribution of the sensory nerves of the female perineum. The left side shows the landmarks and site to enter the needle in blocking these nerves in labor or perineal operations.

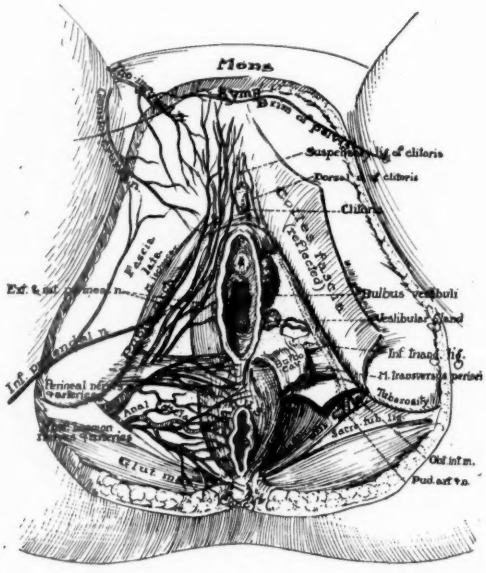


Fig. 2. Dissection of the female perineum. On the right side Colles' fascia is removed showing the sensory innervation and blood supply of the superficial perineal interspace and ischiorectal region. On the left side Colles' fascia is reflected showing the vestibular bulb and gland and the inferior layer of the triangular ligament cut to show the artery of the bulb in the deep perineal interspace. In the ischiorectal fossa the anal fascia is removed and the space cleared showing the location of the pudic vessels and nerves.

The posterior triangle contains the sensory nerves of the region to the coccyx, the anus, Colles' fascia, and the triangular ligament, and a part of the periphery of the anterior triangle.

Fascial planes. The superficial fascia of the anterior triangle consists of two layers: the peripheral layer contains fat and varies in thickness in different women (Fig. 3); it is continued over the posterior triangle forming a meshwork containing the fat of the ischiorectal fossa. The second or superior layer of the superficial fascia of the anterior triangle is Colles' fascia and is an aponeurotic membrane which is very sensitive to pain. Passing forward, this layer is represented by Scarpa's fascia of the abdomen and the suspensory ligament of the clitoris. Across the vaginal orifice it is represented by the sensitive hymen. Posteriorly it is reflected behind the transverse perineal muscles and blends with the two layers of the triangular ligament and the perineal body; laterally, Colles' fascia is attached to the rami of the pubic arch. This fascia forms the floor of the superficial perineal interspace, the roof being the inferior layer of the triangular ligament.

The deep perineal fascia is the urogenital diaphragm or triangular ligament. It also consists of two layers that become continuous behind, blending with the perineal body and Colles' fascia. Anteriorly these layers are separate; laterally and anteriorly, both layers are attached to the pubic arch and between them is situated the deep perineal interspace.

A study of these fascial planes demo ates the ease by which the spaces may be in. trated and the contained structures subjected to the influence of the solution for a considerable time, owing to the impervious nature of the fasciæ and their attachments, when intact, making it impossible for the solution to escape except anteriorly from the superficial interspace beneath Colles' fascia.

The perineal spaces. The superficial interspace contains all of the sensory nerves of the anterior triangle except a few fibers of the genitocrural and ilio-inguinal nerves. It also contains the principal vessels, the superficial muscles, and the vestibular bulb and gland (Bartholin's gland), the location of which must be remembered or failure may result if injection is made into them.

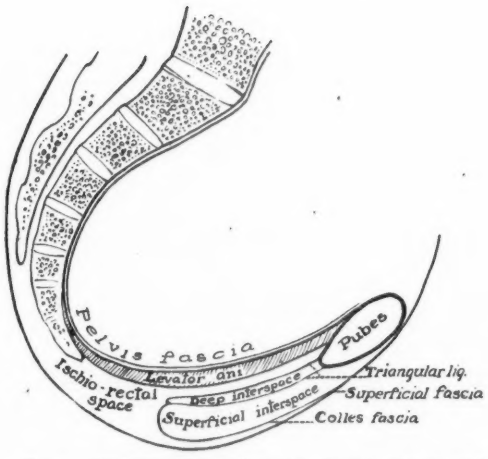


Fig. 3. Diagram illustrating the fascial planes and spaces governing the extent of the anæsthetic infiltration. Note the anterior projection of the ischiorectal space.

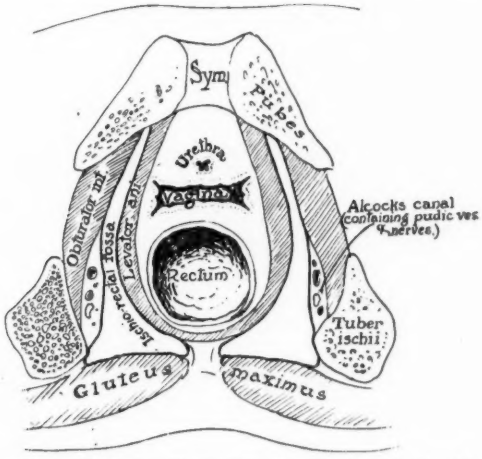


Fig. 4. Diagram illustrating the relation of Alcock's canal and the anterior projection of the ischiorectal fossa.

The deep perineal interspace contains no nerves necessary to block in labor; the dorsal nerve of the clitoris, which enters this space, leaves it and passes into the anterior portion of the superficial interspace.

The ischiorectal fossa is generally stated as being situated in the posterior triangle, but reference to Figs. 3 and 4 will show that there is an anterior projection between the levator ani and the superior layer of the triangular ligament passing nearly to the symphysis. The solution will readily infiltrate the loose tissue of the space, but it is necessary to use a greater amount than in the anterior injection. Alcock's canal, which is a sheath formed by the obturator fascia, contains the pudic nerves and vessels supplying nearly all the structures of the perineum. The situation of this structure, about 4 centimeters above the margin of the tuberosity, marks the depth to insert the needle for the injection. Care must be used not to make the injection into the obturator muscle or the dissipation of the solution may prevent sufficient anæsthesia of the perineum. If the solution is injected into the fossa, it will have effect upon the perineal nerve and also the hæmorrhoidal and sacral nerves giving sensation to the structures of the posterior triangle.

TECHNIQUE

1. Prepare a 2 per cent solution of novocaine in normal saline, sterilize it by boiling, allow it to cool, and add ⅓ of a minim of 1:1000 solution of adrenalin chloride to each cubic centimeter.

2. Palpate the pubic arch to be sure of the landmarks.

3. Wash the site of each injection with alcohol or benzin followed by the official tincture of iodine.

4. Spray each site lightly with ethyl chloride before entering the needle.

5. In the anterior triangle enter the needle 2 to 4 centimeters above the lower margin of the vagina and 2 centimeters from the rami. Pass the needle 2 to 4 centimeters in depth, corresponding to the level of the hymen or its remains, and the expression of sudden pain as the needle meets the positive resistence of Colles' fascia will indicate the proper depth; pass the needle through the fascia and inject the solution. In the anterior triangle, use 1½ cubic centimeters of the 2 per cent solution for each injection.

6. In the posterior triangle incline the needle laterally and enter it midway between the anus and tuberosities to a depth of 4 centimeters. In the posterior triangle use from 5 to 10 cubic centimeters of a 1 per cent solution in each injection. Varying as to the adiposity of the subject.

7. The injections are made bilaterally.

8. Primipara require only the anterior injection.

9. Multipara may require both anterior and posterior injections.

SUMMARY

1. No adverse results have followed nearly 100 injections. A slight superficial necrosis of the inner lips of the labium has followed the injection

of stronger solutions of adrenalin, but this in all cases cleared without harm.

2. Anæsthesia begins in a few minutes and is prolonged two to four hours.

3. Lacerations are diminished in number and extent, for the consciousness without pain of the patient allows retardation or advancement of the presenting part at will, thereby developing the fullest elasticity possible.

4. Hæmorrhage from lacerations is greatly diminished, due to the adrenalin and lessened extent of tears.

5. Repair is greatly facilitated because of the duration of the anæsthesia.

6. Benzin or alcohol and iodine sterilization of the obstetric area can be rapidly and painlessly carried out under this procedure when the posterior triangle is infiltrated.

7. The general practitioner can safely and easily apply the method at the bedside.

AN OPERATION FOR BACKWARD AND DOWNWARD DISPLACEMENTS OF THE UTERUS

By JOHN M. ALLEN, M.D., F.A.C.S., St. Johnsbury, Vermont

THE operation described below has been performed fourteen times during the past twelve months and has given so uniformly good results in all these cases that the writer deems it worthy of report. The fourteen patients presented varying degrees of backward and downward displacements of the uterus, from simple retroversion to complete prolapse. The ages ranged from 25 years to 64 years. In most of the cases repair of the pelvic outlet as well as attention to the cervix uteri was necessary. Where the cervix was badly lacerated, much enlarged, or greatly elongated, it was amputated by the circular method, which measure of course lightened the load markedly.

The abdomen is opened in the midline by a four-inch incision, the lower limit of which is about one and one-half inches above the symphysis pubis. The skin and fat are pushed back from the edges for one-half inch throughout the whole length of the incision and any work upon the adnexa or lower abdominal contents is carried out. Holding the edge of the rectus sheath taut,

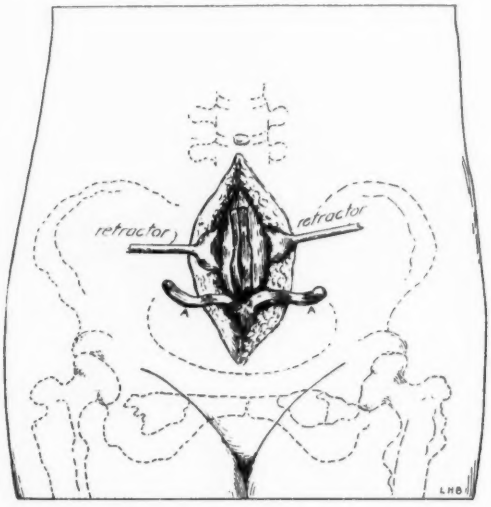


Fig. 1. First step. Two parallel strips *A* cut from the rectus sheath.

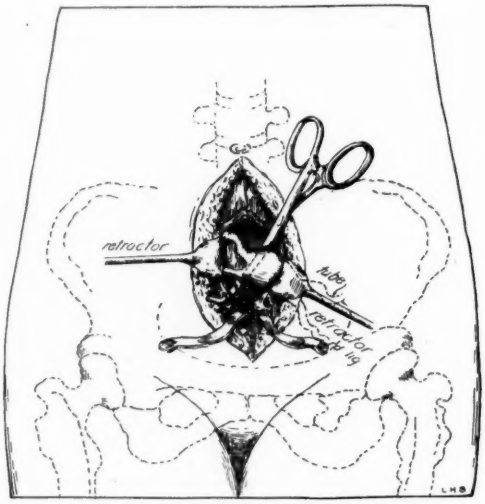


Fig. 2. Second step, showing forceps pushed through broad ligament just below round ligament, from behind forward and up through peritoneum, posterior rectus sheath, and fibers of rectus muscle, ready to grasp end of strip.

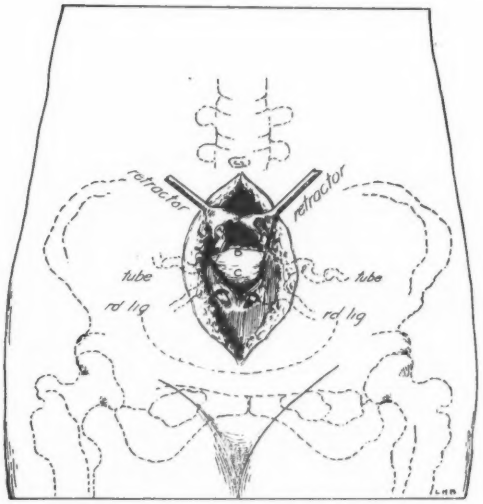


Fig. 3. Third step, showing uterus *C* with incision at *B* and strips *A* ready to be sewed in cross incision on posterior surface of uterus between uterine ends of round ligament.

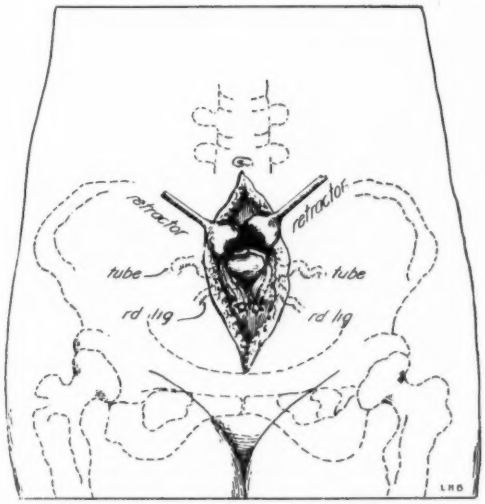


Fig. 4. Fourth step in the operation, showing the uterus in the opening with the strips sewed in the incision and to each other.

a strip of this about one-fourth of an inch wide is cut from the margin as long as the incision. The upper end is severed and the lower end is left attached. The uterus is next brought up high enough to make the posterior surface easy of access as low as the origin of the round ligaments, and a shallow cut is made across this surface from the origin of one round ligament to the same point upon the other side. In making this cut the knife is held at an angle to the uterus of forty-five degrees, so that later on the incision may be completely closed. The uterus is then drawn to one side and held firmly while the next important step is taken. An eight-inch hæmostat, with jaws curved to a right angle with the blade, is thrust from behind forward through the broad ligament on a level with the end of the incision on the posterior surface of the uterus, and made to traverse the following structures in the order named: the parietal peritoneum and posterior rectus sheath, the fibers of the rectus muscle. Thence it is made to emerge at the edge of the wound without having pierced the anterior sheath of the rectus, and at or near the level of the lower end of the incision in this latter structure. The jaws of the hæmostat are then opened and the free end of the strip of the rectus sheath previously cut is grasped and the hæmostat is withdrawn until the jaws appear at the point where they entered; i.e., at the end of the groove in the uterine wall just below the round ligament. The same procedure is carried out upon the opposite side, the ends of the strips are cut to proper length if too long, and they are then sutured carefully to the bottom of the groove with twenty-day gut. The ends may be made to meet in the midline of the uterine wall or may overlap. The cut in the uterus is then sutured with fine gut and one or two stitches are made to include the strip, the round ligament, and the broad ligament on either side. The uterus will then be seen to be in most excellent position, hanging free and unattached to other structures, and no raw surface for adhesions will be found other than the small area upon the two small strips of aponeurotic tissue, which is almost negligible in amount.

The chief advantage claimed for this operation is that the new support is made of tissues which will not stretch out in a few months after active life has been resumed. Also, the uterus is made one of two links of a chain which will hold the vaginal walls in place. Better anatomic position is secured and maintained than in many of the other varieties of operations for the relief of these conditions.

All patients so far have been completely relieved of the distressing symptoms complained of prior to operation. It is of course obvious that this method can only be used in patients past the menopause, or in others where the tubes have been tied or other means of sterilization employed.

SPONTANEOUS EVOLUTION IN SHOULDER PRESENTATIONS

With Report of a Case

By RALPH M. CARTER, A.B., M.D., Green Bay, Wisconsin

STEPHENSON, in a recent article, states that spontaneous evolution in transverse presentations has been observed only twice in 13,000 consecutive labors at the Johns Hopkins hospital, and all authorities agree that it is a very unusual occurrence. On account of its rarity, therefore, a report of the following case may be of interest.

On February 27, 1916, I was called to attend Mrs. K., living eleven miles in the country. I found a woman of 34, five feet six inches in height, and well developed. She informed me that she had passed through five previous labors, all normal and not particularly difficult. Pains in the present labor began about 5 p.m., and the bag of waters ruptured about 8 p.m., followed shortly by the prolapse of an arm. Hard pains then ceased, except for an occasional one. A midwife was in attendance, but with the prolapse of the arm, she rightly decided that the case was beyond her skill.

Under conditions as aseptic as possible considering the circumstances, I made an examination with light anæsthesia, administered by the midwife. I found a right scapulo-anterior, with prolapse of the left arm, which was of good color. The cervix was fully dilated, and the uterus closely applied to the fœtus in the condition of Kilian's "passive contraction." The shoulder was firmly wedged into the pelvis, and it was impossible to get the hand into the uterus to perform a version without using more force than I cared to employ under the circumstances, with absolutely no skilled assistance at hand. As the uterus was not markedly thinned, there were no hard pains, and the patient's general condition was excellent, I decided to move her to the hospital. She stood the trip in the auto very well, arriving at the hospital at the end of the eleven mile drive in practically the same general condition as when we left her home. She had a few pains *en route*, but they were not hard ones.

A few minutes after her arrival, the pains increased markedly, both in number and intensity, and in a short time, she was having violent bearing down pains at intervals of two or three minutes. She was placed immediately on the table, and light ether anæsthesia administered. The prolapsed arm had now become very much swollen and congested, and the shoulder had rotated beneath the pubis. Almost without a pause, spontaneous evolution by the method of Douglas took place. The chest, abdomen, and breech were consecutively forced over the perineum, followed by the legs and the other arm, after which the head was extracted without difficulty. The placenta followed within five minutes.

The child was dead, but as shown by the changes occurring in the prolapsed arm, death had been very recent. It weighed six pounds, and was fully developed. The neck was markedly elongated.

The mother made an uneventful recovery, and left the hospital on the eleventh day.

Transverse presentations are always pathologic. While the above case demonstrates that they sometimes terminate spontaneously, yet with very rare exceptions, the children all die, and very frequently the mothers, if aid is not given. If left to Nature, several terminations are possible:

1. Spontaneous rectification may occur. This usually takes place during the last month, and is brought about by the contractions of pregnancy. It occasionally occurs during the early part of the first stage.

2. Spontaneous version may be brought about during the first stage of labor, or rarely, in the beginning of the second. The head or the breech may come to lie over the inlet, usually the former.

3. Spontaneous evolution may take place.

4. The pains continue, no advance is possible, the uterus ruptures, and the patient dies from hæmorrhage or infection.

5. The pains may cease, the fœtus be retained and become infected, decomposing and giving rise to a physometra, in which condition general sepsis and death usually follow.

Spontaneous evolution may take place according to one of three methods: (1) That of Roederer, also known as *spontaneous expulsion*, or *evolutio corpore conduplicato*. This is much rarer than ordinary spontaneous evolution, and requires a much roomier pelvis in proportion to the size of the fœtus. The shoulder is forced down into the pelvis, and the body is bent, bringing the head and thorax into apposition. Both the latter enter the pelvis together, and emerge simultaneously from the vulva, following the birth of the shoulder. (2) The method of Douglas, of which the above case is an illustration. In this method, which usually occurs in cases with prolapse of an arm, the head is arrested above the inlet, the neck becomes very much elongated, and the chest, abdomen, and breech are forced out alongside the arm, followed by the legs, the other arm, and the head. (3) The method of Denman, which is the rarest of the three. This usually takes place in back posterior positions. The head rotates posteriorly, the shoulder ascending simultaneously with the descent of the breech, which finally comes down and out. A fourth method, or at least a hitherto undescribed modification of the method of

Douglas, has recently been observed by Stephenson. In his case, the left shoulder with prolapsed arm became fixed beneath the pubic arch, as in Douglas' method. Following this, the buttocks emerged from the outlet with their anterior surface in contact with the inner surface of the arm. This latter method must be extremely rare, and the force required for it to take place is undoubtedly very great.

The above-described mechanisms, while they are very interesting in that they demonstrate the marvelous adaptability of the processes of Nature to unusual circumstances, occur so rarely in practice that they should never be depended upon.

For spontaneous evolution to occur, we must have a roomy pelvis, a small, easily molded fœtus, and very strong pains. It always occurs late in the second stage. Once started, however, the rapidity with which the process is completed is astonishing, a fact which has been remarked upon by several observers, and illustrated in my own case. From the onset of the severe pain to the birth of the placenta the time was fifteen minutes. The total duration of labor was eight hours.

Since it is practically impossible to predict in which cases evolution will take place, and since the results of neglected transverse presentations are so serious, expectancy, in the hope of evolution, has no place in the treatment of this class of cases. If seen early in labor, a short wait to see if spontaneous rectification or version will occur may be justified. If neither of these takes place, version should be performed as soon as conditions will permit. Oftentimes deep anæsthesia will allow turning, where otherwise it appears impossible. Above all, gentleness and care in all manipulations should be the first consideration, and if the shoulder is deep in the pelvis, the uterus contracted closely about the child, and the latter does not turn easily, attempts at version should be abandoned. If the lower uterine segment is greatly thinned, version is contraindicated, as a rupture will almost surely occur. In these cases, decapitation should be performed. In exceptional circumstances, when the child is living, the woman is in good condition, and the surroundings favorable, cæsarean section may be considered.

REFERENCES

De Lee. Principles and Practice of Obstetrics, 1913.
Stephenson, H. A. Bull. Johns Hopkins Hosp., 1915, xxvi, 331.
Galabin and Blacker. Practice of Midwifery, 7th ed.
Williams, J. W. Obstetrics, 1906.

BLOOD TRANSFUSION WITH PARAFFIN-COATED NEEDLES AND TUBES

By BETH VINCENT, M.D., F.A.C.S., Boston

THE results obtained by the transfusion of blood are probably less dependent upon the particular method employed than upon any other factor pertaining to the subject. The indications for a transfusion and the selection of the donor are more important than the technique of the operation. The therapeutic value of the blood is the same whether transferred by the citrate method as described by Weil[1] and Lewisohn[2], with the glass cylinders of Kimpton and Brown,[3] the pipet-cannula apparatus of Satterlee and Hooker,[4] or by the syringe method of Lindeman.[5] For this reason each surgeon should familiarize himself with the method which suits his own needs. The following method has been useful to me and may meet the requirements of other operators.

For the past three years I have used a glass tube or flask with a paraffin coating which inhibits the coagulation of blood and allows ample time to transfer it from donor to recipient. The tube resembles in principle and differs in shape from the cylinders described by Kimpton and Brown and the pipet of Satterlee and Hooker.[6] This method is easy and practical but requires a skin incision to expose the vein in both donor and recipient which is not necessary in many cases.

Recently I have modified the tube so that it can be used with a needle of special design which obviates the skin incision on individuals with suitable veins. After a year's experience with the needle and tube at the Massachusetts General Hospital and in my private work I find that this

[1] Weil, Richard. J. Am. M. Ass., 1915, lxiv, 425.
[2] Lewisohn. Surg., Gynec. & Obst., 1915, xxi, 37.
[3] Kimpton and Brown. J. Am. M. Ass., 1913, July 12.
[4] Satterlee and Hooker. J. Am. M. Ass., 1916, Feb. 26.
[5] Lindeman. Am. J. Obst., N. Y., 1913, vi, 28.
[6] Satterlee and Hooker. Surg., Gynec. & Obst., 1914, xix, 235.

is the case with the donor, at least, in a large percentage of transfusions.

The tube (as shown in Fig. 1) is a cylinder with a capacity of 300 cubic centimeters, the upper end of which is closed with a rubber cork. About 3 centimeters below the end is a side opening where connection is made with a bulb syringe which is used to express the contents of the tube. The lower end of the cylinder terminates in a glass tip, through which the blood enters and leaves the tube. About 2 centimeters above the end of the tip is a ground glass joint by means of which a tight connection can be made with the needle.

The needle is 6 centimeters long and consists of a shaft and a socket of about equal length. The socket, which is the special feature of the needle, is made of an unusual depth so that there is no contact between the needle and that portion of the glass tip which projects into the socket below the ground glass joint. The needle is made in two sizes, number 14 and 16 gauge. I find that I use the larger size in most cases.

PREPARATION OF TUBE AND NEEDLE

The tubes are cleansed with hot water, wrapped in a towel with the cork and a short piece of rubber tubing and sterilized and dried in the autoclave. The process of coating the tubes with paraffin is then carried out under aseptic conditions. I have used 54° paraffin and various mixtures of stearin, paraffin and vaseline for coating but find that a commercial article sold under the name of "parowax" serves all practical purposes.

The paraffin which has been melted and sterilized in a metal dish is aspirated into the lower end of the tube and the outlets are covered with pads of gauze while the tube is turned to make the wax run over all the inner surface. The excess of paraffin is allowed to run out at the tip, leaving a small amount in the tube to cover the cork when the tube is placed upon end to cool. This forms a disc of wax which makes the cork airtight, a condition which is essential to the proper use of the tube. As the tube cools a coating of paraffin appears on the inner surface. One should make sure that this covering is uniform and that the outlets are patent before the tubes are done up in sterile towels and put aside for future use.

The needles are cleansed, dried, and heated until sterile in a dish of melted paraffin. With sterile forceps a needle is then taken from the dish and the excess of wax is removed by shaking or by blowing air through the needle with a bulb syringe during the process of cooling to prevent the formation of a plug of wax in the lumen. The needles are then sterile and coated and can be kept in a sterile box until needed.

This process of coating the tubes and needles requires some practice and is bothersome to the surgeon. It is one of the disadvantages of the method but the work can be delegated to any intelligent nurse. Prepared and put up in this way the needles and tubes may be kept indefinitely and are always ready for immediate use.

USE OF NEEDLE AND TUBE

The method of using the needle and tube varies with the case to be transfused and the experience of the operator. The tube should be used without the needle in cases in which the veins of both donor and recipient are small or hidden by a heavy layer of subcutaneous fat, or when the surgeon lacks practice in vein-puncture and is unable to enter the vein without causing a hæmatoma. Under these circumstances it is advisable to expose and open the vein through a skin incision and insert the tip of the tube directly into the vein as described by Kimpton and Brown. The blood is usually taken from one of the larger veins in the donor's elbow; while any vein in the arm or leg which will admit the glass tip can be used in transferring the blood to the recipient.

In most transfusions the veins of the donor are large and easy to puncture with the needle while the veins of an anæmic recipient are apt to be small and hard to locate. For this reason it is usually advisable to take the blood from the donor into the tube by means of the needle, then disconnect the needle from the tube and inject the blood into the recipient through the glass tip which is inserted directly into a small vein previously exposed by skin incision.

Figure 2 shows the manner of using the needle and tube to take the blood from a vein at the donor's elbow. The arm is prepared with iodine and a small amount of novocain is injected into the skin over the selected vein which is made prominent by a tourniquet applied above the elbow. The application of the tourniquet is important; it should be placed directly on the skin and adjusted by the operator so as to secure the maximum venous tension without stopping the arterial flow. The needle is connected to the tube before making the puncture and inserted into the vein toward the wrist. As soon as the vein is entered the blood appears at the bottom of the tube and steadily rises to the top by virtue of the pressure in the vein. The rate of flow is increased if the donor "works the fist" during the procedure. When the tube is filled, which

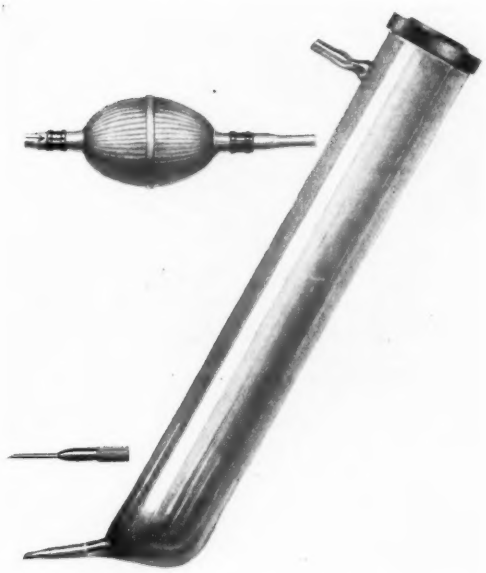


Fig. 1. Coated glass tube with needle and bulb syringe.

Fig. 2. Shows use of needle to take blood from vein at the elbow.

usually takes three or four minutes, the flow is checked by releasing the tourniquet. This should be done before the needle is removed to avoid the formation of a hæmatoma. As the needle, still attached to the tube, is withdrawn pressure is made over the vein at the site of puncture. The needle is then disconnected from the tube and rinsed in cold salt solution. During this time the tube is kept in a horizontal position with the tip up to prevent the escape of blood. To complete the transfer, place the finger over the upper opening of the tube to control the flow of blood, depress the lower end and insert the tip into the vein of the recipient.

Figure 3 shows a tube half filled with blood which is being injected by this technique into the internal saphenous vein just above the ankle.

The average transfusion requires at least 600 cubic centimeters of blood. In most cases, if a hæmatoma does not form around the vein, it is possible to take two and sometimes three tubes of blood from the same vein by reinserting the needle through the original skin puncture. It is not necessary to use a fresh tube and needle for each transfer of blood. If cleansed immediately with cold salt solution they may be employed a second or even a third time in the same transfusion. A single tube and two needles usually suffice for a transfusion although one should always be prepared with at least two coated tubes and extra needles.

The combination of needle puncture for the donor and incision for recipient is the practical method in most transfusions, but under certain circumstances it is possible to use the needle on both the donor and the recipient. In such cases after the tube has been filled with blood from the donor as already described a needle is inserted into the median basilic or median cephalic vein of the recipient made prominent by a tourniquet above the elbow. As soon as blood flows from the needle the tourniquet is loosened, the tube, filled with blood, is connected with the needle and the contents expressed by means of the syringe.

This needle and tube method without incision applies especially well to the infant with an open anterior fontanelle where the blood is injected into the superior longitudinal sinus as suggested by Helmholz.[1]

[1]Helmholz, H. F. Am. J. Obst., N. Y., 1915, Sept.

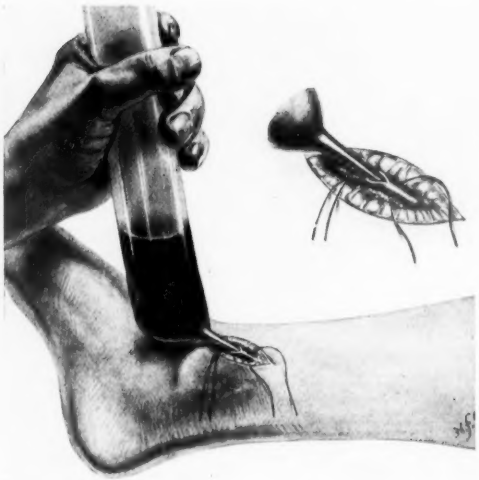


Fig. 3. Shows technique of inserting glass tip into vein which has been exposed and opened through skin incision. Position of tube to inject blood into internal saphenous vein.

Fig. 4. Shows position of infant's head and point at which the injection of blood is made into the longitudinal sinus.

In my last seven cases of hæmorrhagic disease of the newborn I have employed this method with very satisfactory results. The blood is taken by means of the needle from an elbow vein of the father who usually serves as the donor. One half a tube or 150 cubic centimeters of blood is sufficient as the amount required to transfuse these cases varies from 90 to 120 cubic centimeters. The infant is placed at the end of a table with the head on one side, as shown in Figure 4, and held firmly in this position by an assistant. The needle is inserted at the posterior angle of the anterior fontanelle exactly in line with the sagittal suture. The sinus is just beneath the skin and dura and large enough at this point to be located easily even in a newborn infant. As soon as the needle enters the sinus the fact is revealed by the flow of blood from the outer end. The needle is then held firmly in place while connection is made with the tube and the blood is slowly injected. The blood must be injected slowly to avoid a too rapid increase of intracranial pressure. In two of my cases this caused vomiting and disturbed respiration which corrected itself as soon as the flow of blood was checked temporarily. Air pressure in the tube should be released by detaching the syringe before the needle is withdrawn. There is no bleeding of any amount from the sinus even if the puncture has been made with a fairly large needle.

The chief disadvantage of this method of transfusion lies in the preparation of the needles and tubes but this process is not difficult and may be done in advance. The coated needles and tubes can be kept indefinitely and are always ready for immediate use. In practice the method is certain and flexible. The combination of needle and tube allows the surgeon to make a choice of procedures to suit his own operative experience and the need of the individual case. The tube with open incision is a sure method for any transfusion and under favorable conditions the use of the needle with the tube materially simplifies the operation.

WIRING THROUGH THE OBTURATOR FORAMEN FOR SYMPHYSIS PUBIS SEPARATION

Four-inch Separation of the Symphysis Pubis, Protrusion of Bladder between the Separated Bones, Ankylosis of the Sacro-iliac Joints; Invalidism, Failure of Postural and Supportive Measures; Restoration of Pelvic Girdle by Wiring through the Obturator Foramen

By SYLVESTER J. McNAMARA, A.M., M.D., F.A.C.S., Brooklyn

SEPARATION of the symphysis pubis sufficient to cause invalidism is rare.

The history of the case is that of a woman 38 years old; the mother of six children. The patient is of small stature and is inclined to be corpulent. She was attended by the same physician in all six confinements, the last one being instrumental. She was not able to get around after the last confinement, unless she supported herself on a chair which she pushed in front of her.

Six months after her last delivery she was taken with severe pains in her right side and was removed to the Kings County Hospital, where she was operated on for acute gall-bladder disease. When it was time to leave the bed it was found that she could not walk, and an examination showed a separation of the symphysis pubis to the extent of four inches, with a fluctuating tumor between the separated bones, which was found to be bladder.

Postural treatment and various devices were used, but the patient complained so bitterly that they had to be discontinued. Compression by various appliances, including support by a plaster-of-Paris girdle taking one thigh, was tried, but with no success. A stout pigskin girdle reinforced and shaped to her hips was put on and she was allowed to go home.

At no time were we able to bring the separated ends of the bones near enough together to hope for union even though we could find a device to hold them there.

Furthermore all attempts to bring the symphysis together caused the patient to cry out with the intense pain produced at the sacro-iliac joints. After a short time at home she returned to the hospital in about the same condition we first found her. After various consultations with my colleagues on the gynecological and obstetrical services, as well as with the general and orthopedic surgeons, it was decided to bring the bones together by surgical means. The study of the symphysis in the dried specimen did not argue well for plating, owing to the cancellous nature of the bone, irregularity of surface, and the nature of the strain. The obturator foramen presented one possible route for safe and firm support.

A crescentic incision about seven inches long was made, exposing the space between the separated ends, and the separated ends of the joint were exposed, mostly by blunt dissection. As the patient was in the elevated lithotomy position, a catheter was placed in bladder because of the unusual distortion of the urethra and displacement of the bladder. The field of operation was enlarged by a longitudinal incision downward. An attempt was made here to bring the separated joint together by two of the assistants making lateral pressure, but without result.

The patient was turned on the side and one of the assistants with all his weight and strength and a jumpy-jerky motion finally succeeded in breaking up the adhesions that had formed at the sacro-iliac joint and allowed the separated symphysis to come together.

The patient was replaced in the dorsal position, and with one finger behind the pelvic bone the obturator foramen was located on the patient's left. A gigli needle was passed on the finger, followed by carrier, and a No. 12 silver wire was carried over to the right side and passed from within out and brought together in front and slowly twisted, assisted at each twist by lateral compression. Particular attention was given to see that the bladder and urethra were not injured either by the compression or by the suture.

As the separated ends came closer and closer together, the twisting of the wire became more difficult, chiefly for two reasons: first, the receding oblique surface of

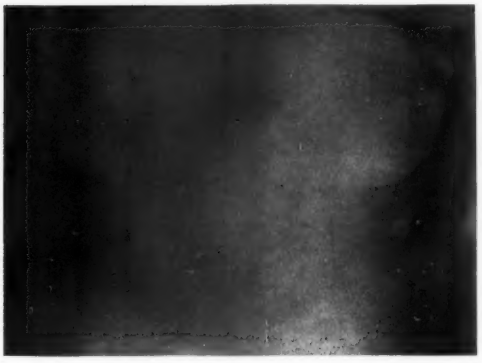


Fig. 1. Four-inch separation of symphysis pubis.

Fig. 2. Showing distortion of the sacro-iliac joint.

Fig. 3. Post-operative roentgenogram showing wire through the foramen and plate across the symphysis.

Fig. 4. Roentgenogram showing result 6 months after operation.

the symphysis, and second, the strain of the silver wire as evidenced by the great force necessary to twist it. The wire was twisted until the bones were in contact, the ends of the symphysis having been previously curetted.

Feeling that this single suture did not fulfill all the requirements for fixation of the pelvic girdle, two single Lane plates, one screw in each end, were placed across the symphysis, and the wound closed, leaving a small gutta-percha drain in each angle.

Convalescence was rapid and complete. Healing took place *per priman* throughout except at the site of one drain, which continued to discharge a serosanguinolent fluid of small quantity which was later found to be due to a small piece of the gutta-percha drain that became separated and kept up the irritation.

Eight weeks after the first operation, as the roentgenograms showed that the screws in the Lane plates had become dislodged, the plates were removed, perfect union followed, and the patient was allowed to sit up with a supporting belt on.

It was now about 18 months since she had walked unaided, and it was necessary for the patient to learn again how to step. This was accomplished and she left the hospital walking very well on the level, but a little diffident on going up and down stairs.

It is now more than six months since the silver wire was inserted through the obturator foramen and up to this time it has given no sign of its presence there.

CONCLUSIONS

1. That inability to walk during the post-partum convalesence should call for an examination of the symphysis pubis.
2. That any separation of the pubic joint should call for a retention apparatus of suitable size and fitted to keep the separated bones in contact.
3. That in cases of unusual separation which are of long standing, the obturator foramen affords the safest and surest method of restoring the integrity of the pelvic girdle.
4. That in our hospital records no case has presented itself requiring operative procedure for separation, nor has any analogous case been found in surgical literature.

TRANSPLANTATION OF THE ABDUCTOR HALLUCIS TENDON IN THE SURGICAL TREATMENT FOR HALLUX VALGUS

By JOSEPH E. FULD, M.D., New York
Instructor in Operative Surgery, College of Physicians and Surgeons, Columbia University; Assistant Visiting Surgeon, Gouverneur Hospital

ANY operation for hallux valgus must have in view (1) the correction of the deformity, (2) the prevention of recurrence, (3) the preservation of the longitudinal arch.

The usual operation of the resection of the head of the metatarsal bone meets only the first requirement. To meet the second requirement, I devised and found feasible a transplantation of the tendon of the abductor hallucis from its usual insertion in the plantar surface of the base of the first phalanx to the periosteum covering the middle of the inner surface of the same bone. To meet the third requirement, I have confined the bone section to the exostosis, when possible,

Fig. 1. Showing bony projection. *A-B*, Line of excision.

without resection of the head, and follow this by suture of the capsule over the denuded bone area, deep to the transplanted abductor tendon, to prevent involvement of the transplanted tendon in the subsequent and inevitable callus.

The histories of a moderately large number of cases treated by this operation show that it will be rarely necessary to resect the head of the metatarsal bone.

After a thorough trial of the various operative methods, this operation has given me the best results. The simplicity, ease, and safety with which it can be performed, in my opinion, warrant its trial in these cases. It allows the patient to walk well and absolutely without pain; the great toe remains in perfect position and is naturally mobile; and it does not affect the weight-bearing function of the foot.

TECHNIQUE

The steps of the operation are as follows:

1. Under general anæsthesia, forcibly move the great toe in all directions, stretching the contracted tissues.

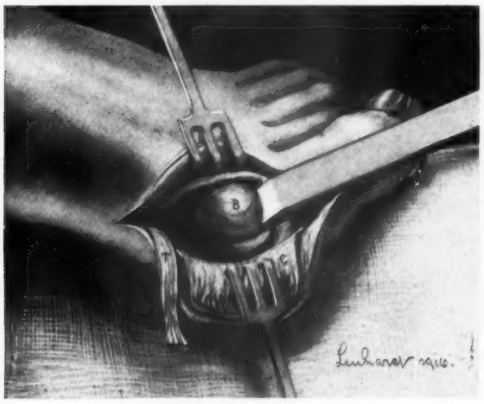


Fig. 3. *B*, Bony projection; *T*, tendon of abductor hallucis; *C*, capsule.

Fig. 2. *C*, Capsule; *T*, tendon of abductor hallucis to be transplanted.

2. Paint the foot and toes with iodine.

3. Make a slightly curved incision, about two inches long, beginning one-half inch in front of the bony prominence on the inner side of the great toe. A semicircular flap of skin and subcutaneous tissue is dissected free from the bursa and turned down over the joint, so that the subsequent scar will not be at a point of pressure (Fig. 1).

4. The soft parts are retracted. The tendon of the abductor hallucis is now seen under the head of the metatarsal bone and is dissected free from its attachment to the base of the first phalanx (Fig. 2).

5. A flap is now made, including the bursa, capsular ligament, and periosteum, and turned down, exposing the bony deformity to view (Fig. 3).

6. Apply the chisel to the bone at the junction of the condyle and globular head of the meta-

Fig. 4. *T*, Tendon transplanted and sutured; *C*, capsule sutured.

tarsal, and excise the hypertrophied bony projection longitudinally backward (Fig. 3).

7. Irrigate the wound with hot saline solution.

8. Replace the capsule to cover the raw surface of the bone and fix it with catgut sutures.

9. The tendon of the abductor hallucis is now transplanted to the middle of the inner surface of the first phalanx, and sutured with fine silk, or Pagenstecher thread, to the periosteum (Fig. 4).

10. Close skin in usual manner.

11. A plaster-of-Paris bandage is applied to the foot and toe, holding the toe in a slightly overcorrected position, and allowed to remain for a week or ten days.

AFTER-TREATMENT

If the patient carefully observes instructions as to the wearing of properly shaped shoes, no further post-operative treatment will be necessary.

APPARATUS FOR USE AFTER HARE-LIP OPERATIONS

By HERBERT L. SMITH, M.D., Nashua, New Hampshire

FOR many years I have used a device made of brass spring wire to take the strain from the sutures after hare-lip operation. The wire is bent into a shape something like a broad wishbone, the end of each arm pushing the cheek and lip toward the median line. Ordinary corn plasters are fixed to the loops of the wire. These will adhere to the skin for ten days or more.

Although I use deep tension sutures of silk on the inside of the lip it is chiefly the wire spring which holds the edges in position. The mucous membrane is sutured with catgut and the skin with horsehair. The method of application is shown in the illustrations. In this case the apparatus was made of No. 10 wire. In older children a larger size has sometimes been used. The accompanying picture was taken a week after operation.

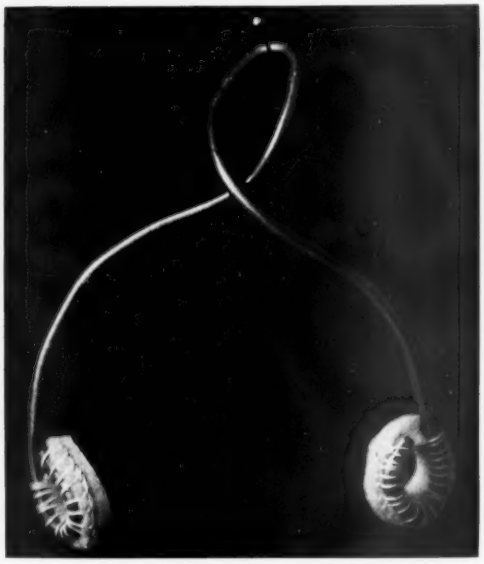


Fig. 1. Device made to keep the strain from sutures after hare-lip operations.

Fig. 2. Patient one week after operation showing device in position.

AN IMPROVED SUBSTITUTE FOR IODIZED CATGUT SUTURES

II. Bacteriological Tests

By CASSIUS H. WATSON, B.S., M.D., Brooklyn

In a previous communication (1), the author reported certain experiments which demonstrated that a double salt of iodine—potassium mercuric iodide—possessed marked advantages over iodine for the impregnation of catgut sutures. Briefly, the results were as follows:

1. Potassium mercuric iodide in watery and alcoholic solutions possesses more than ten times the germicidal efficiency of iodine.

2. Sutures impregnated with this double salt have a tensile strength 6.5 per cent greater than plain sutures, and 16.5 per cent greater than iodized sutures.

3. Sutures impregnated with the double salt, when sealed in tubes containing a suitable storing medium, show no deterioration when the tubes are subjected to boiling water.

The substitution of potassium mercuric iodide for iodine seemed to constitute such a distinct improvement in the preparation of antiseptic sutures that it was deemed desirable to develop a method for thus impregnating suture materials, and then to subject such products to exhaustive bacteriological tests. The experiments reported below were planned to determine —

1. The efficacy of the procedure in producing sterile sutures, and

2. The degree of antiseptic or germicidal powers imparted to such sutures by their impregnation with potassium mercuric iodide.

To this end, therefore, raw, dehydrated catgut sutures were treated with an alcoholic solution of this salt, placed in tubes with various storing fluids, and the tubes sealed. Heat sterilization was omitted in order to make the conditions of the test more exacting. All tests were controlled with samples of plain, chromic, and iodized catgut from several reliable manufacturers.

I. SUTURES TESTED

1A. Plain catgut No. 3, impregnated with potassium mercuric iodide. Batch 1.
1B. Plain catgut No. 3, impregnated with potassium mercuric iodide. Batch 2.
2A. 20-day chromic No. 3, impregnated with potassium mercuric iodide. Batch 1.
2B. 20-day chromic No. 3, impregnated with potassium mercuric iodide. Batch 2.
3. Iodized catgut No. 3. Manufacturer A.
4. Iodized catgut No. 3, cold process. Manufacturer A.
5. 30-day chromic catgut No. 1. Iodized. Manufacturer B.
6. 20-day chromic catgut No. 2. Iodized. Manufacturer B.

Fig. 1. Catgut sutures impregnated with potassium mercuric iodide imbedded in agar infected with staphylococcus pyogenes aureus. Five-sixths natural size.

Fig. 2. Iodized catgut sutures imbedded in the same medium. Five-sixths of natural size.

7. 20-day chromic catgut No. 2. Iodized. Manufacturer B.
8. Iodized catgut No. 2. Manufacturer C.
9. Iodized catgut No. 2. Manufacturer D.
10. Iodized catgut No. 2. Manufacturer E.
11. Iodized catgut No. 2. Manufacturer F.
12. Iodized catgut No. 2. Manufacturer G.
13. Iodized catgut No. 2. Manufacturer H.
14. Iodized catgut No. 2. Manufacturer I.
15. Iodized catgut No. 3. Manufacturer J.
16. Iodized catgut No. 2. Manufacturer K.
17. Iodized catgut No. 2. Manufacturer L.
18. Iodized catgut No. 2. Manufacturer M.

II. STERILITY TESTS

Experiment 1. Technique. The tubes containing the sutures were immersed for one hour in warm bichloride of mercury solution (1:200), drained free from the solution, broken, the suture removed with sterile forceps, washed quickly and thoroughly in 100 ccm. sterile water, the adherent water roughly removed by draining the suture against the inner surface of the container, and then immediately placed in tubes containing 75 ccm. of nutrient broth. Duplicates were planted in similar tubes of broth covered with a thick layer of sterile liquid paraffin to insure anaerobic conditions. All tubes were incubated for seven days at 37.5° C. At the end of that time, if no visible growth had appeared, as a further control, agar slants were inoculated with portions of the broth in which the suture had been incubated. Twelve tubes each of lots 1 and 2 were tested.

Result. All tubes showed absence of growth, and subinoculation of the broth on agar proved their sterility.

Experiment 2. Sutures of both plain and chromic catgut impregnated with potassium mercuric iodide were not tubed, but instead were preserved in paper envelopes. They were subjected to no heat sterilization, and, further, no precautions were taken in handling them to prevent bacterial contamination. Twelve sutures were tested as in Experiment 1.

Result. All remained sterile.

Experiment 3. In order to determine whether the absence of growth in the broth in Experiments 1 and 2 was due to the actual sterility of the sutures or to the inhibiting action of the impregnating substances on bacteria already in the gut, the strands from ten of each of the incubated broth tubes of sutures 1 and 2 were removed under aseptic precautions, washed again in water, and planted in fresh tubes containing 75 ccm. of broth.

Result. In no case was there growth.

The outcome of Experiments 1, 2 and 3 would seem to attest the efficiency of the method for insuring the complete sterilization of the suture materials.

III. COMPARATIVE BACTERIOSTATIC EFFICACY OF SUTURES IMPREGNATED WITH IODINE AND WITH POTASSIUM MERCURIC IODIDE.

Experiment 4. Twelve tubes from lots 1A and B and 2A and B and four tubes each of all the other lots were first tested for sterility by the method described above. After seven days incubation all were found to be sterile.

To each tube was then added 0.1 ccm. of a 24-hour broth culture of a virulent and actively growing strain of staphylococcus pyogenes aureus. Table I shows the result after a further incubation of seven days.

TABLE I.

Lot	TUBES											
	1	2	3	4	5	6	7	8	9	10	11	12
1A	O	O	O	O	O	O	O	O	O	O	O	O
1B	O	O	O	O	O	O	O	O	O	O	O	O
2A	O	O	O	O	O	O	O	O	O	O	O	O
2B	O	O	O	O	O	O	O	O	O	O	O	O
3	G	G	G	G	..	..	..	..	..	..	..	..
4	G	G	G	G	..	..	..	..	..	..	..	..
5	G	G	G	G	..	..	..	..	..	..	..	..
6	G	G	G	G	..	..	..	..	..	..	..	..
7	G	G	G	G	..	..	..	..	..	..	..	..
8	G	G	G	G	..	..	..	..	..	..	..	..
9	G	G	O	O	..	..	..	..	..	..	..	..
10	G	G	G	G	..	..	..	..	..	..	..	..
11	G	G	G	G	..	..	..	..	..	..	..	..
12	G	G	G	G	..	..	..	..	..	..	..	..
13	G	G	G	G	..	..	..	..	..	..	..	..
14	G	G	G	G	..	..	..	..	..	..	..	..
15	G	G	G	G	..	..	..	..	..	..	..	..
16	G	G	G	G	..	..	..	..	..	..	..	..
17	G	G	G	G	..	..	..	..	..	..	..	..
18	G	G	G	O	..	..	..	..	..	..	..	..

O, No growth. G, Growth.

Experiment 5. To test further the inhibiting action exhibited by all the sutures of lots 1A and B and 2A and B and of two sutures of lot 9 and one suture of lot 18, the broth tubes containing these particular sutures were then inoculated with a 5 mm. loopful of a 48-hour pellicle of a pure culture of bacillus subtilis. The result may be thus tabulated.

TABLE II

Lot	TUBES											
	1	2	3	4	5	6	7	8	9	10	11	12
1A	O	O	O	O	O	O	O	O	O	O	O	O
1B	O	O	O	O	O	O	O	O	O	O	O	O
2A	O	O	O	O	O	O	O	O	O	O	O	O
2B	O	O	O	O	O	O	O	O	O	O	O	O
9	G	O	..	..	..	..	..	..	..	..	..	..
18	G	..	..	..	..	..	..	..	..	..	..	..

In none of the tubes containing sutures 1A and B and 2A and B was there growth, while only one tube of lot 9 showed freedom from infection. The inhibiting power of the sutures impregnated with potassium mercuric iodide was marked.

Experiment 6. In order to determine whether the inhibition of growth in the tubes containing sutures 1, 2, and 9 was due to an antiseptic or a germicidal action, the following test was made:

From six tubes each of lots 1A and B and 2A and B, which had been inoculated with staphylococcus, from six tubes each of lots 1A and B and 2A and B inoculated with bacillus subtilis, and from one tube of lot 9, all of which had shown no growth on incubation (Experiments 4 and 5), 0.1, 0.5, and 1.0 ccm. of the broth was pipetted in 75 ccm. of fresh broth. The purpose was to dilute the possible content of impregnating substance dissolved from the suture in the first broth tube and by this dilution to do away with any purely inhibiting action. If growth occurred, it would then show that the suture possessed merely antiseptic properties; while, if no growth occurred,

it would indicate that the catgut contained a sufficient amount of the impregnating substance not only to inhibit but actually to kill the organisms. The result is shown in Table III.

TABLE III

Lot	TUBES											
	Staphylococcus							B. Subtilis				
	1	2	3	4	5	6	7	8	9	10	11	12
1A.....	O	O	O	O	O	O	O	O	O	O	O	O
1B.....	O	O	O	O	O	O	O	O	O	O	O	O
2A.....	O	O	O	O	O	O	O	O	O	O	O	O
2B.....	O	O	O	O	O	O	O	O	O	O	O	O
9.....	G	..	..	..	..	..	..	..	..	..	..	..

Experiment 7. Sutures of lots 1, 2, and 12 were washed in sterile water, placed in deep petri dishes, then covered with fluid agar which had been inoculated with staphylococcus aureus, and the plates incubated.

It was felt that such an experiment would, in the first place, approximate *in vitro* the conditions existing about a suture planted in human tissues; further, it would demonstrate to what degree impregnating substances diffuse through such a medium and to what extent an antiseptic or germicidal zone is thus created.

Figures 1 and 2, show in a striking way the marked inhibitory power of catgut impregnated with potassium mercuric iodide as compared with iodized catgut. The lighter areas about the imbedded sutures represent zones of no bacterial growth, while the darker portions in the plates are masses of staphylococcus colonies. It should further be remembered, as has been shown in Experiment 6, that in the case of the former sutures the inhibiting action is truly germicidal, while in the case of iodized sutures the action at most is only antiseptic. It seems particularly significant that the potassium mercuric iodide can diffuse and exert an inhibitory action to such an extent through a medium as dense as agar. Iodine, on the other hand, has only a slight diffusibility.

If this experiment can be considered as a criterion of the conditions obtaining about a suture imbedded in human tissues, it is evident that catgut sutures, impregnated with potassium mercuric iodide, protect the tissues against bacterial infection to a much greater degree than do the usual iodized sutures.

DISCUSSION

Experiments 1 and 2 demonstrate that the process of impregnating catgut sutures with potassium mercuric iodide renders them sterile, and the efficacy of the method is attested by Experiment 3, which shows that even when such sutures are preserved and handled with entire neglect of aseptic precautions they remain sterile. In Experiments 3, 4, and 5 the results prove that sutures impregnated with potassium mercuric iodide have sufficient inhibitory power to prevent the growth of staphylococcus pyogenes aureus and even of the sporulating bacillus subtilis, while the ordinary iodized sutures have little or no such action (one suture out of 64 inhibited both the staphylococcus and bacillus subtilis, but failed to kill them). Experiment 6 shows fur her that this inhibiting action of potassium mercuric iodide is not merely bacteriostatic but is truly germicidal.

CONCLUSIONS

1. Potassium mercuric iodide is an improvement over iodine for the impregnation of suture materials in so far as their physical properties are concerned (1).

2. Sutures impregnated with potassium mercuric iodide possess a decidedly greater inhibiting power on the growth of bacteria than do sutures impregnated in the usual way with iodine.

3. The inhibiting action of potassium mercuric iodide sutures is a germicidal one.

BIBLIOGRAPHY

WATSON, CASSIUS H. An improved substitute for iodized catgut sutures. Surg., Gynec. & Obst., 1916, xxii, 114.

MACFARLAN, DOUGLAS. Notes in the study of potassium mercuric-iodid. J. Am. M. Ass., 1914, lxii, 17.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FRIDAY EVENING, APRIL 21, 1916, WITH THE PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

EXTERNAL INCOMPLETE RUPTURE OF THE UTERUS FOLLOWING SUBPERITONEAL HÆMORRHAGE

DR. A. J. WEIGEN (Augustana Hospital, service of Dr. R. W. Holmes):

On February 27, 1916, at 10:15 p.m., Mrs. A. H. was admitted to Augustana Hospital in labor. The patient was married, 38 years of age, mother of six children, the oldest being 16 years and youngest 4½ years. Each birth had been normal and easy. Labor was due February 17, 1916, as the patient had menstruated last on May 10, 1915. The patient did not know when she conceived or when life was felt. From the history obtained it would seem she had had no trouble during the pregnancy. On February 26 at 10:30 p.m., the patient went into labor. At 2.30 a.m. the following morning a physician was called and found the head floating, membranes intact, and slight amount of dilatation. At 2:30 p.m. the same day, the head was fixed, with complete dilatation, and the membranes intact, which were then ruptured artificially. At 5 o'clock the occiput was to the right and the head low. Without anæsthesia forceps were attempted several times, but without success in locking the instrument. As the patient had not been prepared on admission to the hospital she was taken care of at the hospital by the nurse in the delivery room. The patient was catheterized, but only a few drops of bloody urine was obtained. Labor was strong and the pulse was 114 at 10:45 p.m., after the preparation was completed. Five minims of pituitrin was given hypodermatically and contractions became active: diastasis of recti muscles was very marked. At 10:50 the pulse was 132. Five minims more of pituitrin was given hypodermatically and at 11:05 o'clock a female child weighing 8 pounds 13 ounces was born spontaneously. At 11:10 the placenta was expressed by Crede.

At 11:20 the patient had a pulse of 140, and respiration of 32, and was fairly comfortable. Sometime after midnight she vomited a large amount of yellow fluid. Proctoclysis of 500 cubic centimeters of normal salt-solution was given at 2 a.m. and again at 6 a.m. and all was absorbed. The patient did very well and at 5:30 p.m. the first day of the puerperium (February 28), the patient was given an ounce of oleum ricini on account of dyspnœa from excessive tympany and an enema the following morning with good results. At 2 p.m. the first day of the puerperium (February 28) the patient was catheterized. As the patient had voided 4 ounces at 10:30 a.m., the catheterized urine was cloudy, specific gravity 1027, it was acid, albumin was present, ¼ gram per liter, leucocytes 1, hyaline casts, granular casts 2, and some amorphus urates were found.

On the second day of the puerperium (February 29) at 4 p.m. the patient had a temperature of 101°, pulse of 128, and respirations of 28; no chest findings. There was considerable tympany, but the patient stated that she always had this with each puerperal period and that she usually got relief with oleum ricini. From that time on patient had fever, involuntary bowel-movements, and was not doing well. About midnight (March 1) the patient vomited a great deal of coffee-ground fluid, but after gastric lavage she felt quite comfortable. The following morning she complained of severe abdominal pains and vomited a great deal of clear fluid. The temperature was 101°, pulse 140, thready, weak, and of poor volume. Respirations were 24. At 4 p.m. the fourth day of the puerperium (March 2), the temperature was 104°, pulse 140, repirations 36, and there were involuntary bowel-movements. During the afternoon of March 3 and morning of March 4, the patient had involuntary urination but was quite comfortable. Temperature 100.1°, pulse 112, and respirations 38, at 4 a.m.

About 8 a.m. on the fourth day of March, the fifth day of the puerperium, the patient suddenly collapsed, the pulse became thready and weak and of low volume, recorded as 160 at 8:50, vomited coffee-ground material, became pulseless, and died at 10:35 that morning.

Post-mortem examination of her pelvic viscera was permitted and this was performed by Dr. Karl Lewis. The abdomen was distended, and on opening the peritoneum, an almost explosive gush of blood escaped from the incision, running over onto the floor. Few fresh adhesions were present. The uterus was hardly involuted. The peritoneum separated from the uterus from within the left broad ligament across the anterior wall almost to right broad ligament. The bladder was separated to the vaginal attachments. In the uterine wall under

the left broad ligament, an incomplete external rupture was found. This was probably due to a rupture of an intramural blood-vessel, with a development of a subperitoneal hæmatoma, which when dissected separated the loosely adherent peritoneum of the anterior uterine wall and the bladder and ruptured enteroabdominally on the fifth day of the puerperium.

The baby was born with asphyxia pallida and was revived with difficulty. The child did not breath well for 10 to 15 minutes and oxygen was administered. The following morning it died, respirations becoming slower and slower. The child had several convulsions.

DR. RUDOLPH W. HOLMES: On admission, this patient was exceedingly tympanitic, which continued until her death. She stated she always had this tympany with each puerperium. The question arose, had the uterus been bruised by the forceps attempts, was the injury due to prolonged pressure of the lower segment against the pelvic brim, or was it due to stretching of the lower segment, that is, a threatened rupture of the uterus? On account of the tympany this could not be determined. In a cursory review of the literature, I find the report of a case in the service of the Boston Lying-in Hospital some ten years back which presented a rupture of a sinus posteriorly in the lower segment. The patient died of an intraperitoneal hæmorrhage. We know that vessels rupture occasionally into the broad ligament, producing a broad ligament hæmatoma.

A MEMBER: When do you think the rupture occurred?

DR. HOLMES: Unquestionably during labor, or at least shortly post-partum. Unquestionably an interstitial, intramuscular, hæmatoma formed within the cavity found in the uterine wall under the anterior fold of the left broad ligament. Later, under the influence of the mild peritonitis and metritis, the wall broke externally after an extensive dissecting hæmatoma had raised the loosely adherent peritoneum and bladder, and on the fifth day the peritoneum ruptured. It may not be questioned that the hæmatomatous sac ruptured at 8.30 a.m. when her collapse came.

A MEMBER: How do you account for the blood which was present in the bladder when she entered the hospital?

DR. HOLMES: Hæmaturia is not infrequently found in labor, especially obstructed labor, due to pressure, congestion, with minute apoplexies of the vesical mucous membrane, and rupture.

A MEMBER: Was the bladder separated from the uterus?

DR. HOLMES: From the appearance of the specimen the primary rupture occurred at the left broad ligament, at which point there was a distinct cavity which almost extended down to the uterine mucosa. The loosely adherent peritoneum of the anterior uterine surface was stripped off from the left to the right broad ligament. Likewise, the entire bladder was separated from the uterus down to the attachment to the vagina. It was as completely accomplished as it would have been in a total hysterectomy.

PERITHELIOMA AND ENDOTHELIOMA OF THE UTERUS

Dr. W. A. Newman Dorland read a paper entitled, "Perithelioma and Endothelioma of the Uterus."

A CRITICAL REVIEW OF THE LITERATURE PERTAINING TO THE RELATION BETWEEN GYNECOLOGY AND NEUROLOGY

Dr. Richard R. Smith, Grand Rapids, Michigan, read a paper entitled, "A Critical Review of the Literature Pertaining to the Relation between Gynecology and Neurology."[1]

THE LEUCOCYTES IN PREGNANCY, LABOR, AND THE PUERPERIUM

DR. JOSEPH L. BAER read a paper (by invitation) entitled "The Leucocytes in Pregnancy, Labor and Puerperium." (See p. 567)

DISCUSSION

DR. CHARLES S. BACON: I think the tables given will be very interesting for study when one can look them over a little more carefully than has been possible here.

I have been in the habit of making a routine count generally on the first or second day after labor, simply for the purpose of comparing that with a subsequent count that would be made in case of any rise in temperature. We have found always a rather high leucocytosis, about agreeing with that given in the tables tonight. The difference in the reports of various authors have been so great that I had about given up any hope of making any use of the leucocyte count in general in determining the prognosis of the case in any respect whatever. I regard this as the best collection of cases, certainly the best work that I know anything about, and I believe that we will make use of it in the future.

DR. GILBERT FITZ-PATRICK: In order to check up some of these findings we carried on some investigations in our own clinic. We made use of Bier's pump during lactation, and after having used the pump on several occasions, in comparing the count we found, where the pump had been used rythmically at nursing and then making a count shortly afterward, there was a slight tendency toward an increase of the lymphocytes.

A CONTRIBUTION TO THE ETIOLOGICAL STUDY OF OVARITIS

DR. CARL HENRY DAVIS (by invitation) read a paper on "A Contribution to the Etiological Study of Ovaritis." (See p. 560)

[1] Published in Internat. Abs. Surg., 1916, xxiii, 117.

DISCUSSION

DR. C. S. BACON: Without attempting to discuss this paper, I would like to ask one or two questions. I understood that the author assumed that fibrocystic degeneration and ovaritis are synonymous terms. I do not know exactly why. I understand that it is assumed that bacteria cause the fibrocystic degeneration. I do not know why. To prove that ovarian infection must be hematogenous two cases were given where there was no connection between the vagina and the ovary. In one of those cases, however, there had been an abdominal operation with drainage, and of course that would furnish a mode of entrance for the bacteria into the ovary. In the other case there was no such possibility, but I suppose there was the possibility of an infection by the lymphatic route.

Although these objections do not by any means show that there is not a hemotogenous infection of the ovary, and I suppose all must admit its possibility, still in the establishment of a positive pathogenesis, and carrying it so far as to suggest the treatment of local infections as local foci for the prevention and cure of infection in other parts of the body it is necessary or desirable at least to absolutely eliminate other methods of infection.

DR. N. SPROAT HEANEY: Experience shows that a blood-borne infection can cause pelvic inflammation, as witness the occasional suppurations with bacillus typhosus of ovarian cysts in the course of typhoid fever. I have had one ordinary pelvic abscess which developed during a typhoid fever and yielded the bacillus typhosus in pure culture. Dr. Davis' cases with blocking of the lower passages through malformations of development and chronic inflammatory changes in the absence of a history of acute disease absolutely show that also chronic pelvic lesions may result from infection brought through the blood stream. Now, since other departments of medicine and surgery through the work instituted by Rosenow show daily convincing evidences of the production of chronic inflammatory processes in various organs as a result of a chronic distant focus it does not seem strange to me that the same may be true of the pelvis as is true of other fields. It may be a question as to whether this work of Dr. Davis is conclusive in this particular point; that chronic cystic disease of the ovaries results from blood-borne streptococcus viridans infection from distant foci.

DR. MARK GOLDSTINE: What has always puzzled me in a case of chronic ovaritis where one opens the abdomen and finds both ovaries affected is which one of the ovaries will be sterile, which one will give trouble later on, and which one is infected by the streptococcus viridans? If we leave the ovary the patient comes back with symptoms worse than the symptoms of the artificial menopause, because she has had a severe operation and still has the pain she complained of before the operation: and a patient who has been operated upon and has not been cured of her symptoms is not satisfied.

I would like to have Dr. Davis explain how we can tell, when both ovaries seem diseased, which one is sterile, and which one is not.

DR. DAVIS (closing the discussion):

While the possibility of a lymphatic infection in these cases has to be taken into consideration, the experimental work which has been carried out and which you can read in the *Journal of the American Medical Association*, April 15, 1916, I think gives pretty strong evidence of the hæmatogenous origin. So far as telling which ovary to leave and which one to take out, I do not know any more about how to choose between them now than I did two or three years ago. I have studied and gone over carefully the symptoms which are given by the patient. I studied the pathological findings as recorded by the operator; I have studied the ovaries as seen under the microscope, and I do not know anything more about how to choose between them now than I did three or four years ago. So that when I am operating on a case I keep in mind and have the nurse re-read to me the carefully recorded history of the symptoms, and if I find two ovaries with apparently not much choice between them, in a young woman, and her pain has all been on the right side, I make it a practice to leave the left ovary. If her pain has been on the left side I make it a practice to leave the right ovary.

CORRESPONDENCE

To the Editor: I find that through an error in copying the manuscript for Dr. Murphy's article on "Bone and Joint Disease in Relation to Typhoid Fever," which appears in the August issue of SURGERY, GYNECOLOGY AND OBSTETRICS, credit was not given to Dr. Charles M. Jacobs for certain paragraphs taken from his excellent article "Spontaneous Luxation of the Hip-Joint as a Sequel of Typhoid Fever," which was published in the April 1914 issue of the *American Journal of Orthopedic Surgery*. We greatly regret this unfortunate error and wish to say that it was an unintentional oversight that Dr. Jacobs' name was omitted.

D. MATTHIAS, Secretary to the late Dr. Murphy.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By MAJOR G. SEELIG, M.D., St. Louis

FOR several months past there have appeared comparatively few books devoted to the technical side of surgery. Recently, by contrast, the technical side has been emphasized again; and this month we have three volumes devoted almost unqualifiedly to the Simon pure art side of surgery. Of course, a coincidence of this sort — and it is a mere coincidence — calls for no comment. The activities of men as individuals and as groups always show a tendency to manifest themselves in waves. There is this of interest, however, in the three volumes under consideration: namely, that each embraces a different field of technique, thus driving home the lesson that even the so-called carpentry side of surgery demands for its mastery a fairly wide acquaintanceship with an ever-broadening field of activity; a field broadening with such rapidity and such inevitableness that specialization is being forced upon us willy-nilly not only by the demands of an academic grasp of fundamentals, but also by the requirements of specialized technical procedures. We shall probably revert to this later in the review. For the time being it is only necessary to point out that one of the three books is a hardy perennial on general technique — an operative surgery, written by a master, and appearing now in its seventh edition; another deals solely with the technique of the administration of anæsthetics; and finally the last one is devoted to technical procedures on the upper air passages.

As a whole, the three treatises are clear cut, concise, and admirably specific both in their purpose, and in the way they set about to accomplish it. This is saying much, for, as a rule, the average description of a simple operative procedure is mildly maddening. I have often thought that much of the travel side of surgery — the peripatetic meanderings to the clinics of other men — owes its origin to the fact that the descriptive art of surgical writing is so feebly developed. Men want to see for themselves that which the cold and unresponsive printed page fails to drive into their consciousness. In furnishing a tentative explanation of these surgical wanderings, I am of course not deprecating them; for they are truly among the best things in the life of a surgeon. The point is, that men find difficulty in describing a complicated act on paper. The following quotation, selected from the writings of a humorist is apropos and illustrates the point to perfection. A friend writes to the humorist inquiring how to tie a bow tie, and receives the following answer: "You hold the tie in your left hand and the collar in the other. Slip your neck in the collar, and cross the left hand end of the tie over the right with the left hand, steadying the right end with the other hand. Then drop both hands, catching the left with the right, and the other with the other. Reverse hands, and pick up the loose ends with the nearest hand. Pull this end through the loop with your unengaged hand, and squeeze. You will find the knot all tied and all you have to do is to untangle your hands."

WHEN one finds himself face to face with a heavy tome like this seventh edition of Binnie's classical work[1] he covertly prays for the gift of condensation. Very recently a critic demonstrated this gift, by reviewing Binnie's *Operative Surgery* in remarkably small compass, driving home his opinion in the following short introductory sentence: "In the dozen years Binnie's *Operative Surgery* has been before the profession, it has grown steadily in size and importance, until it has become as nearly indispensable a reference work as such a book can be." An affirmative and well intonated "Amen" to the above expression of opinion would constitute an adequate book review in this instance; for those who know their Binnie demand no critique and those who do not know him ought surely to have acquaintanceship forced upon them by the information that he is indispensable.

Convention demands, however, more than a recommendation to purchase. It therefore becomes necessary to point out that the seventh edition, like its predecessor, appears in one volume form — bulky and full, but manageable with perfect comfort. In common with all the previous editions, this one sets up as its aim the "constant endeavor to give aid to the surgeon when he is in trouble." One fact alone furnishes assurance that the aim has been accurate, and that fact is the large number of men who, in past years, have expressed their dependence upon this book.

The general management of the parts remains as heretofore. There are evidences scattered throughout the whole volume of emendations and deletions and there is a notable addition of quite a number

[1] Manual of Operative Surgery. By John Fairbairn Binnie, A.M. C.M., F.A.C.S. 7th ed., revised and enlarged. Philadelphia: P. Blakiston's Son & Co., 1916.

of new cuts that illustrate the text admirably. Several of these cuts are from remarkably recent current literature. In all, three new chapters have been added, one on cardiac surgery, a short one of nearly three pages on retroperitoneal neoplasms, and an appendix on war surgery, written by Dr. Walter S. Sutton. This chapter by Dr. Sutton, although it is particularly well done, considering the exigency of space, seems to mirror the tendency of the times rather than to possess any large inherent surgical value. This opinion, however, may be faulty owing to the fact that supersaturated as we all are with surgical war reports written *in extenso*, we are very apt to sniff at a résumé of thirty pages.

There is practically nothing of consequence in the field of operative surgery that one cannot find in this volume. Furthermore, when he finds it, it is described, without exception, in the most unmistakable fashion. There are no bow tie fiascos lying around loose. If one were forced to point out defects he could only mention several bits of evidence of careless proof-reading, and possibly suggest that Dr. Binnie, for safety's sake, should point out more clearly the dangers inherent in the various proposed methods of curing hydrocele by the injection of iodine, carbolic acid, and other irritant chemicals. In a book of this sort more space ought not be devoted to instilling caution than to describing methods of introducing potential agents of gangrene into closed cavities.

But after all has been said the final fact remains that the book comes about as near being a surgical bible as anything non-biblical can.

THIS next book[1] limits itself to the technique of anæsthesia. Practically everyone who will first read the preface carefully and then go through the text, will reach the conclusion that this volume is in a class by itself. It has been said by someone that good writing depends most largely upon proper thinking. Here is a book that seems to have been thought out well in advance of writing it. There is a definiteness of arrangement, a clearness of exposition and a critical selection of data that makes it serve exactly the purpose that the author had in mind; namely, "a ground work upon which the student, interne, and general practitioner may acquire a more comprehensive knowledge of the art of anæsthesia." I know of no other text that I would so gladly place in hands of junior internes; indeed, the great body of internes have been waiting for a practical treatise of just this sort.

Of course it is true that one lays down the book, after going through the three hundred odd pages, without a new concept of the theory of anæsthesia, of the literature of the subject, or of the underlying physiology or physiological chemistry of the lecithin bodies; but if one cavils at this, it is because he failed to read the preface, and therefore missed the purpose of the work. Flagg's object is distinctly the *art* as contrasted with the *science* of anæsthesia; and it is art with a large A, for nowhere in the text does one find a scintilla of evidence of polemic adherence to any special technique of administration. "Nothing," Flagg very wisely says, "should be permitted to dominate over the art in the broader sense." The technical principles underlying the use of anæsthetics serve as the keynote in every chapter.

And these chapters are cleverly arranged so as to be very inclusive without being burdensome to the beginner. Part I, made up of thirteen chapters, is devoted to general anæsthesia, local anæsthesia and mixed anæsthesia. Under general anæsthesia, there is a discussion of complete and incomplete (rausch) general anæsthesia, a detailed discussion of the induction and maintenance of and recovery from general anæsthesia, the signs of anæsthesia, their significance and interpretation, ether by the oral, pharyngeal and intratracheal insufflation methods, ethyl chlorid, chloroform, and finally nitrous oxide alone and in combinations with oxygen and ether. Each anæsthetic is dealt with under the headings "General Considerations," and "Technique of Administration," and always in the most eminently practical fashion. Carefully selected illustrations do much toward clarifying the text.

The twelve pages devoted to local anæsthesia are necessarily totally inadequate and we believe the author could have left them out to advantage, merely confining himself to volatile anæsthetics. Local anæsthesia has grown to dimensions far and away beyond small compass, even when skilfully condensed by Flagg. Of course, such a change of title would have cut out the chapter on mixed anæsthesia, but still we think it would have been worth while. By "mixed anæsthesia" Flagg means "spinal anæsthesia." Heretofore the phrase "mixed anæsthesia" has referred to compounds such as the A. C. E. mixture, or to mixed local and general anæsthesia. We wonder whether Flagg has not introduced an element of confusion in changing the nomenclature.

Part II is devoted to "Factors Incidental to the Actual Adminstration of the Anæsthetic," and discusses preliminary medication, post-operative treatment, duties of the nurse, before, during, and after anæsthesia, rebreathing, emergency anæsthesia, anæsthetist's records, aspirators, and finally a closing chapter on "The Point of View of the Patient." This final chapter on "The Point of View of the Patient" is, in its way, a classic. It breathes a spirit that one rarely encounters in a medical book, and ought to be issued in leaflet form and taught catechism fashion to every anæsthetist, be he embryonic or full fledged.

THIS next volume[2] is the one referred to earlier in this review as forcing upon us the conviction that even from the purely technical side we are grad-

[1] THE ART OF ANÆSTHESIA. By Paluel J. Flagg, M.D. Philadelphia and London: J. B. Lippincott Company, 1916.

[2] PERORAL ENDOSCOPY AND LARYNGEAL SURGERY. By Chevalier Jackson, M.D. St. Louis: The Laryngoscope Company, 1915.

ually being forced into more limited surgical specialization. The development of specialties within specialties and the gradual conquest of the more inaccessible cavities of the body to surgical approach have been very interesting phenomena in the history of medicine. Nowhere, perhaps, is this evolution more aptly illustrated than in the field of laryngology. From Bozzini's first attempts to explore the human larynx by means of his crude laryngeal speculum and Garcia's subsequent perfection and practical employment of the laryngoscope until the achievements of the present day, the march of progress may be said to have followed instrumental and mechanical inventive genius. The simple Garcia laryngoscope had its limitations, for the more inaccessible parts of the larynx could not be examined with it. The introduction of suspension laryngoscopy and bronchoscopy by Killian and by Bruenings marked an epoch in laryngeal surgery rendering possible the employment of surgical measures in the deeper parts of the tracheobronchial tree. The efforts of Jackson have still further developed this field of laryngology so that today endoscopy and laryngeal surgery constitute a special field in themselves.

Until within comparatively recent years lung surgery through the bronchi and the removal of foreign bodies from these parts was practically unknown. Jackson, by his instrumental innovations, his high degree of technical skill and by the repeated demonstrations of his methods upon the profession, has so simplified the technique of this comparatively new and difficult branch of surgery that he has placed it within the reach of the surgeon of average skill. In considering, therefore, Professor Jackson's *Peroral Endoscopy and Laryngeal Surgery* it must be remembered that this field owes its advancement and its present technical development to the ingenuity of the author himself.

The work is not a textbook in the general acceptation of the term. It is an exhaustive reference work that unquestionably occupies the premier rank in this field. The volume, consisting of 705 pages, is not confined solely to bronchoscopy and œsophagoscopy. It deals fully with the surgical conditions of the tracheobronchial tree and the œsophagus. Symptoms and diagnosis are omitted except in so far as they are necessary for the elucidation of the endoscopic text. The essential aim of the author has been to devote his subject matter to the technical aspects of endoscopy and laryngeal surgery and their associated operative problems. The author is quite candid in the discussion of his results and in order "that bronchoscopy, like any other department of science, shall profit by its failures" he gives (pages 318-327) the histories of some of his unsuccessful cases of bronchoscopy and points out the reasons for the unavoidable lack of success. The book is divided into two parts. The second part is devoted to laryngeal surgery, taking up the consideration of "Tracheotomy," "Intubational Dilatation of Laryngeal Stenosis," "Laryngectomy," etc., and is intended for the already experienced surgeon. The same may be said to apply to part one.

Although Jackson is an enthusiastic advocate of direct laryngoscopy he nevertheless makes it a rule, whenever such examination is possible, to examine every case by the indirect method first, except in infants and in urgent cases in adults.

What will appeal to the reader is the orderly arrangement of the work and the thoroughness with which details, usually skimped, are discussed. Thus the subjects of instruments (the author showing preference, of course, for those of his own invention or modification and with which he has obtained the best results), anæsthesia, source of light, introduction of the œsophagoscope, etc., are taken up separately and in minutest detail.

That the acquiring of skill in bronchoscopy, especially in the extraction of foreign bodies, means traveling over an exceedingly rocky road may be judged from the author's dictum that "no one should think of attempting for the first time to remove a foreign body from a human being until he has at least 100 times removed a foreign body from a dog." And again: "Endless patience is an essential . . . . The greatest percentage of successes will accrue to him who is so constituted to work calmly and deliberately, yet quickly and accurately, under severe stress of prolonged work with one eye . . . where a mistake or lack of promptness or accuracy may mean the death of the patient . . . . "

The chapters on "Foreign Bodies in the Larynx and Trachea," "Mechanical Problems of Foreign Body Extraction," "Œsophagoscopy for Foreign Bodies," "Bronchoscopy in Diseases of the Trachea and Bronchi," "Diseases of the Œsophagus" (the latter comprising 89 pages), are all exhaustive treatises on their respective topics and reflect Dr. Jackson's wide experience and keenness of observation. This brings up another point: While other laryngologists may differ with Jackson on some points, Dr. Jackson's statements bear the stamp of deep conviction resulting from broad experience.

The book is profusely and splendidly illustrated and it is safe to predict that when the warring nations in Europe will have resumed their former positions in peaceful science, there will be a demand for the translation of the work, certainly into German, and perhaps also into other foreign languages.

P. F.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE MEDICAL CLINICS OF CHICAGO. Vol. II, Nos. 1 and 2. Philadelphia and London: W. B. Saunders Company, 1916.

THE CLINICS OF JOHN B. MURPHY, M.D., AT MERCY HOSPITAL, CHICAGO. Edited by P. G. Skillern, Jr., M.D. August, 1916. Philadelphia and London: W. B. Saunders Company, 1916.

DISEASES OF CHILDREN. By Edwin E. Graham, A.B., M.D. Philadelphia and New York: Lea & Febiger, 1916.

BACTERIOLOGY — GENERAL, PATHOLOGICAL, AND INTESTINAL. By Arthur Isaac Kendall, B.S., Ph. D., Dr. P.H. Philadelphia and New York: Lea & Febiger, 1916.

THE TREATMENT OF DIABETES MELLITUS, WITH OBSERVATIONS UPON THE DISEASE BASED UPON ONE THOUSAND CASES. By Elliott P. Joslin, M.D. Philadelphia and New York: Lea & Febiger, 1916.

THE DIAGNOSIS AND TREATMENT OF SURGICAL DISEASES OF THE SPINAL CORD AND ITS MEMBRANES. By Charles A. Elsberg, M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1916.

THE AMERICAN YEARBOOK OF ANÆTHESIA AND ANALGESIA. F. H. McMechan, A.M., M.D., Editor. New York: Surgery Publishing Company, 1916.

A PRACTICAL TREATISE ON DISORDERS OF THE SEXUAL FUNCTION IN THE MALE AND FEMALE. By Max Huehner, M.D. Philadelphia: F. A. Davis Company, 1916.

THE EXPECTANT MOTHER AND HER CHILD. By Margaret J. Modeland, R.N. With introduction by Harold A. Miller, M.D. Philadelphia: The John C. Winston Company, 1916.

THE PRACTICAL MEDICINE SERIES, VOL. IV — GYNECOLOGY. Edited by Emilius C. Dudley, A.M., M.D., and Herbert M. Stowe, M.D. Chicago: The Year Book Publishers, 1916.

THE MOTHER AND HER CHILD. By William S. Sadler, M.D., and Lena K. Sadler, M.D. Chicago: A. C. McClurg & Co., 1916.